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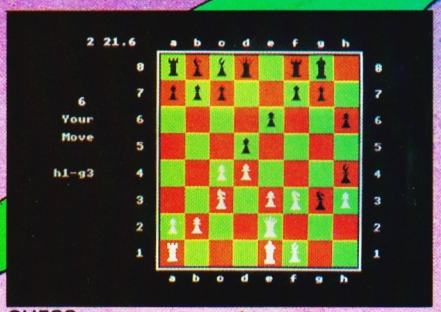

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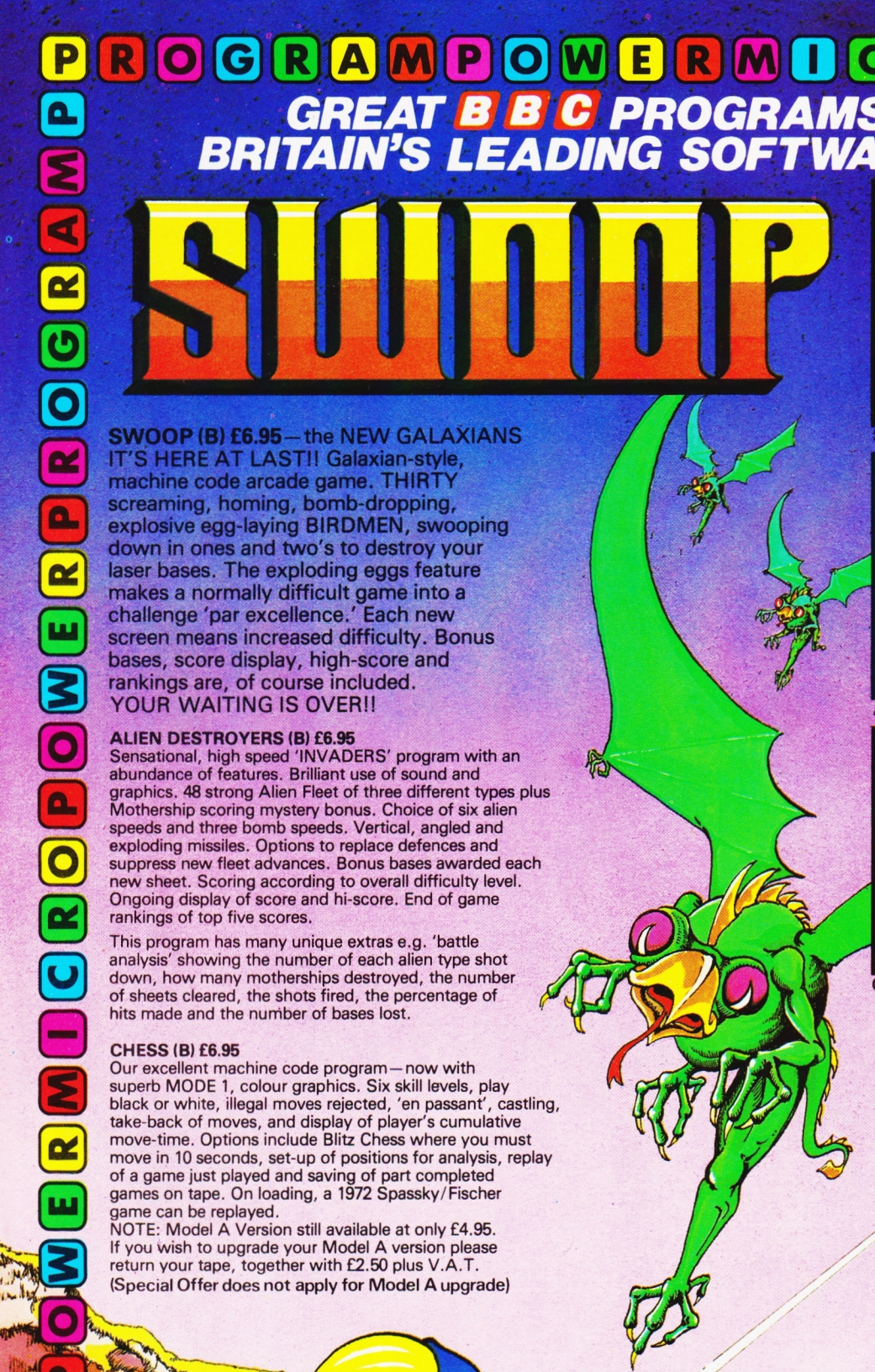

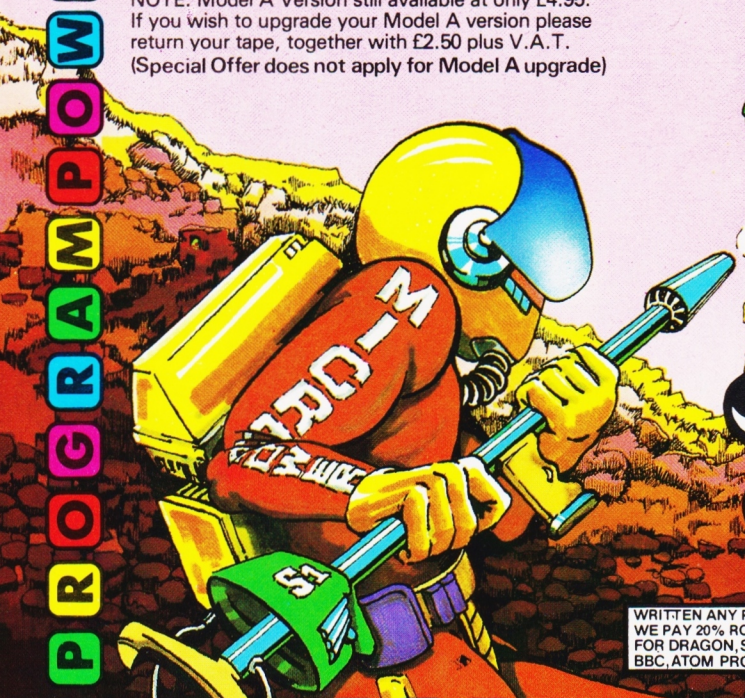

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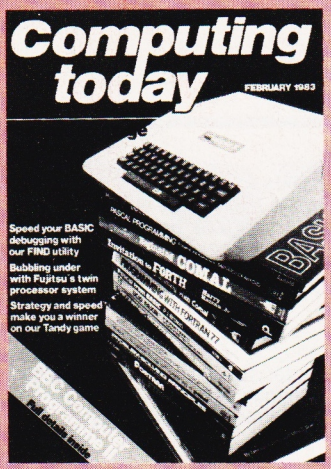

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All material should be typed. Any programs submitted must be listed (cassette tapes and discs will not be accepted) and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Editor at our Charing Cross Road address.

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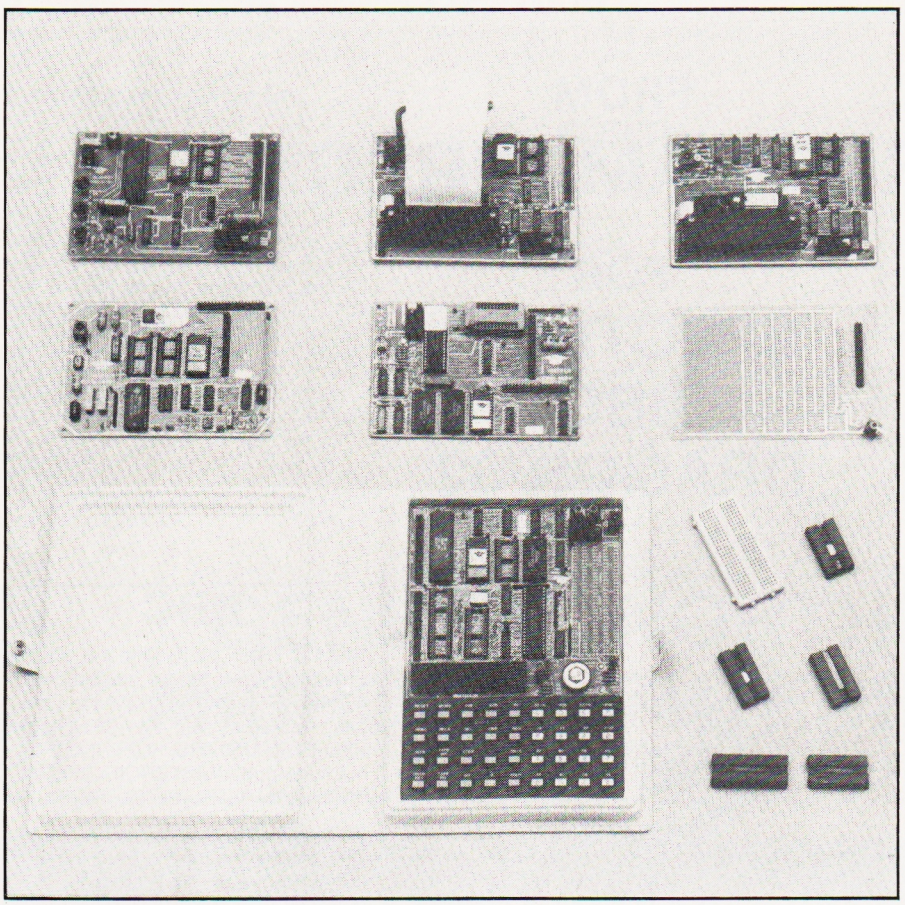

THE TEACHING MICRO▲

Multitech, who introduced the Micro-Professor (MPF-I) microcomputer in 1981, have now completed the full series of system expansion cards and tutorial manuals for the unit with the introduction of a Sound Generation Board (SGB-MPF) and the MPF-I Workbook.

With the SGB, the MPF-I can be used as an electronic organ, to record the user's melodies or to create special sound effects. The retail price, approximately £45, includes a high quality speaker. The Workbook is a tutorial for any beginner who intends to use the MPF-I microcomputer to learn about hardware and software, using Z-80. For further information, please contact: Flight Electronics, Flight House, Quayside Road, Bitterne Manor, Southampton, Hampshire S02 4HD.

LATE LAUNCH

Sad news for those awaiting the new computer from Binatone expected in January. However, you shouldn't have too wait too long — the launch is now planned for March. The delay is due to a redesign incorporating new ICs that have now become available. Binatone is intending to launch two models in March and we'll let you have all the details as soon as we hear of them. In the meantime you can get further information from Binatone International Limited, Binatone House, Beresford Avenue, Wembley, Middlesex HA0 1YX.

BILINGUAL MICRO

Potential Oric owners will be glad to hear of the new 32K version of the Oric I, priced at £139.95 (including VAT). The Oric I is now available in three versions — 48K (£169 including VAT), 32K and 16K (£99.95 including VAT). For mail order purchasers the price of the 48K version includes FORTH as a second language on a free cassette; the cassette will be available as an optional extra at £15 for purchasers of the 48K and 32K models. All versions of Oric I use an extended version of BASIC as their first language. Full information on the Oric range is available from Oric Products International, Coworth Park, London Road, Ascot, Berkshire SL5 7SE, or on 0990-27641 (sales).

DEALING WITH EPSON▼

Norbain Micro Limited has been appointed the first national dealer for the new Epson HX-20 hand-held micro. The HX-20 is the first full-function eight-bit hand-held micro with integral printer, display and microcassette drive. The LCD has both alphanumeric and full graphics capability, with a window showing up to 20 characters by four lines at any one time. The printer has up to 24 characters on a line and utilises a 5 by 7 dot matrix format. The microcassette drive has a capacity of around 50K. Other features include a 16K RAM and 32K ROM expandable to 32K and 64K respectively, as well as RS232 and serial interfaces allowing external printer, external cassette drive and an acoustic coupler to be readily used.

Norbain Micro has initiated its own software development and evaluation programme for the HX-20 and will also be offering full, nationwide maintenance support services for the unit. For more information, contact Norbain Micro Limited, Norbain House, Boulton Road, Reading, Berkshire RG2 0LT.

FRUITY KEYBOARDS

If you use the Apple II computer, you will probably want to hear about two new utility keyboards for use with the Apple. The Key Pad is intended to simplify tedious data entry tasks. It provides 13 keys (0-9, decimal point, minus sign and ENTER) and is easily attached to any Apple II computer. A low profile design simplifies fingering and arm positions and allows either hand-held or desk top use.

The Softkey is a special version of the Key Pad, and allows the user to enter special characters not provided on the normal Apple II keyboard. Complete command character strings may also be entered. Software drivers are provided on the 5¼" disc supplied for Applesoft, and Pascal language versions are available, 15 single clear keycap covers and a set of pre-printed key legends are included which are suitable for various applications. Double keycaps are also available. The Key Pad costs £89 (without VAT) and the Softkey costs £115 (without VAT). For further details, please contact Wego Computers Limited, 22a High Street, Caterham, Surrey, or 'phone 0883-49235.

ATARI CUTS COSTS

It has been announced that the Atari 800 Home Computer will be retailed at the reduced price of £399.99. The new price includes an Atari BASIC language cartridge, self teaching guide and BASIC reference manual. The reduction in price has been made possible because of the success of the company in the UK. For more details, write to Atari International (UK) Limited, Windsor House, 185 Ealing Road, Alperton, Wembley, Middlesex.

CUSTOMER SERVICE▶

It's encouraging to learn that at least some of the high street retailers of home computers will have some idea about the products they are trying to sell us, such as the basics of programming. To aid in this endeavour a unique computer training scheme for all members of Dixons' retail management has been recently introduced by the Company in conjunction with Commodore Business Machines (UK) Limited and Microtraining, a company specialising in teaching basic programming and instructional techniques on home computers.

Using the Commodore VIC-20 colour computer, the Directors of Microtraining present details of computer hardware and software, teach the attendees how to write meaningful programs and demonstrates how off-the-shelf software such as Commodore's Vicfile and Simplicalc can help Dixons' customers obtain maximum benefit from the purchase of a home computer. Each course comprises 20 hours of intensive training and more than 300 Dixons' staff will attend one of the courses.

PRICES SLASHED!

If you were thinking about buying a micro in the PC-8000 range, then now would seem as good a time as any to buy. NEC have cut the suggested retail price of the PC-8000 systems by an average of 13%, although the price varies slightly for different hardware and software items.

Following on from the NEC cuts, Bonsai have also dropped the price of their NEC PC-8000 micros by one-third. A full CP/M system, comprising processor, keyboard, screen and two disc drives, now costs just £1,179, a reduction of £526. A complete word processing system can now be purchased for £2,995, including a daisy wheel printer, as a result of Bonsai's second major price cut in a matter of months. In July 1982, the company was able to drop the price of their own-label SM-3000 machines because of an improved supplier arrangement. For further details, write to Bonsai Limited, 112-116 New Oxford Street, London WC1A 1HJ, or 'phone 01-580 0902.

LOOK SHARP THERE!

Sharp are launching some new products at the Which Computer Show. One of these is the new pocket computer, the PC-1251, which successfully combines a small size with a large memory capacity of 24K ROM and 4.2K RAM. It runs a version of BASIC extended from that on the PC-1211, including two-dimensional arrays and full string handling commands. Memory in RAM is protected by a battery back-up when the machine is not in use. The machine has a QWERTY-style keyboard with separate numeric pad, a 24 character LCD and works for up to 300 hours on one battery. The PC-1251 costs £79.95 (including VAT).

Also on display will be the highly versatile hand-held microcomputer, the PC-1500, and the newly introduced RS232 interface, which allows the PC-1500 to communicate with other computers either directly or over the telephone lines with an acoustic coupler. The PC-1500 costs £169.95 (including VAT), and offers a QWERTY keyboard and add-on four colour printer plus cassette interface.

An ink jet colour printer will be previewed at the show. The machine has the ability to print in seven colours to produce a high resolution image of 120 dots per inch. We were unable to ascertain a price for this printer, but for information on this or any other product described, contact Sharp Electronics (UK) Limited, Sharp House, Thorp Road, Manchester M10 9BE, or 'phone 061-205 2333.

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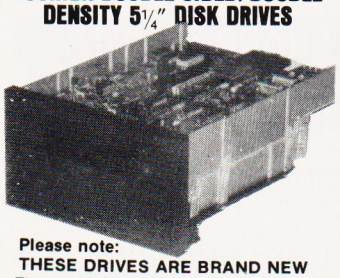

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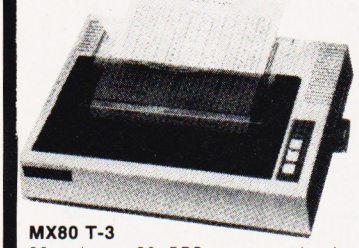

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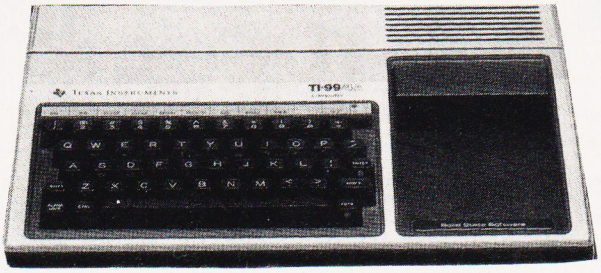

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Touch sensitive TALK, CALL and LOCK controls. Just plug into mains, no installation needed. 3 speech channels (150, 200 and 250 KHz) on each unit. Phase locked loop FM circuitry give noise free operation, built in automatic squelch. Use as many stations as you like. Price per station:
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£28 + VAT = £32.20

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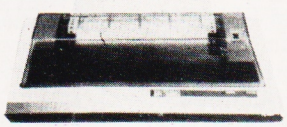
We guarantee that our prices are the lowest on the market. If you can find any item advertised and in stock at less than our price we will match that price.

SEIKOSHA GP SERIES GRAPHIC PRINTERS



GP-100 30 CPS, 80 column, Hi-Res graphic line repeat function, adjustable up to 10" paper width, tractor feed, 5 x 7 dot matrix.
GP-100A centronic parallel interface **£179 + VAT = £205.85**
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GP-250X New 50 CPS, 80 column, tractor feed, true descenders, 64 user defined characters, double height and/or double width characters, 5 x 8 dot matric, parallel and serial (RS232) interface.
GP-250X ..... **£219 + VAT = £251.85**

SMITH-CORONA TP-1 DAISY WHEEL PRINTER

TP-I Text Printer is a microprocessor controlled high quality daisy wheel printer which gives better quality printout at 120 words per minute. Ease of drop-in ribbon cassettes and quick change snap-on daisy print wheels are two additional standard features. TP-1 is available with either Centronic parallel, RS232 serial or IEEE interface (please specify the one you require). This makes it compatible with BBC, TRS80, DRAGON, NASCOM, PET and lots of other computers. Additional daisy wheels of 10 different typestyles are available. S.A.E. for further details.

TP-1 PRICE £429 + VAT

Additional Print Wheels . **£7.50 + VAT each**
Replacement ribbons..... **£2 + VAT each**

COMPUTER PAPER

PLAIN SINGLE PART FANFOLD 11" x 9½" 60 gms **£9 + VAT = £10.35 per 1000 sheets (MINIMUM ORDER 2000 SHEETS)**

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- Connect Four..... **£18 + VAT = £20.70**
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- Tombstone City..... **£18 + VAT = £20.70**
- Wumpus ..... **£18 + VAT = £20.70**
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- Strange Odyssey ..... **£18 + VAT = £20.70**
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- Ghost Town..... **£18 + VAT = £20.70**
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A lot more Software is available. S.A.E. for list.

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Not licensible in UK

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This is a long range (2-5 miles) cordless extension phone with intercom facility between portable hand set and the base station. You can receive all incoming call and dial out to anywhere in the world from the hand set from any location within 5 mile radius of your home or office. The maximum range is achieved by using roof top optional antenna.(not included).
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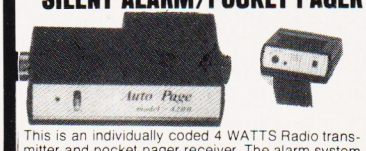
This mobile telephone fits into your car and enables you to receive and make calls to anywhere in the world from within 40 mile radius of your home or office (use rooftop antenna).
Car Telephone ..... **£1195 + VAT = £1374.25**

SILENT ALARM/POCKET PAGER



This is an individually coded 4 WATTS Radio transmitter and pocket pager receiver. The alarm system has connectors for door contacts and vibration sensors. 2 vibration sensors are included. It has a range of 2 miles. Ideal for protection of vehicle or property. Power requirements for transmitter is 12V dc. Not licensible in UK.

PRICE..... **£78 + VAT = £89.70**

BBC MICROCOMPUTER

BBC Microcomputer Model B..... **£347 + VAT**
Model B + Disk interface..... **£409 + VAT**
Parallel printer — GP100A..... **£179 + VAT**
Parallel printer cable..... **£12 + VAT**
Games paddles ..... **£11 + VAT**

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Value - MicroValue - Micro

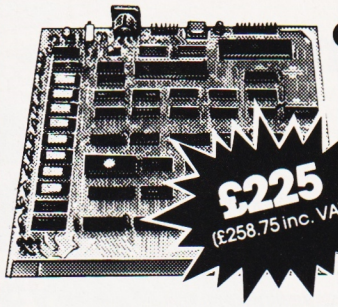
80-BUS MULTIBOARDS

The Gemini Multiboard Microsystem provides a large and growing range of fully compatible microcomputer boards. Around these boards you can configure a solution to satisfy your own particular microprocessor needs, whether you need as many as 10 boards or as few as one. This flexibility is made possible by Gemini's adoption of a number of accepted industrial standards; especially the 80-BUS, specifically designed for the Z80A

The Z80A (the high speed version of the Z80) is now the largest selling microprocessor worldwide, and forms the heart of the MultiBoard system. The principal advantage of a Z80A based system is the abundance of software that is available, and the majority of those packages operate under the CP/M disk operating system. With CP/M software becomes machine independent; providing the user with literally the widest range of software available.

With MultiBoard an almost unlimited number of system permutations are possible. Six of the most popular boards are shown here, but there is a range of 15 available from your MicroValue dealer; together with mother boards, frames, cables, power supplies, keyboards and compatible software if required.

Your MicroValue dealer can also provide the opportunity to build on the Galaxy computer, which uses Gemini MultiBoards, but has two spare slots in a five-board frame for particular configurations.



GM813 — CPU/64K RAM Board

£225 (£258.75 inc. VAT)

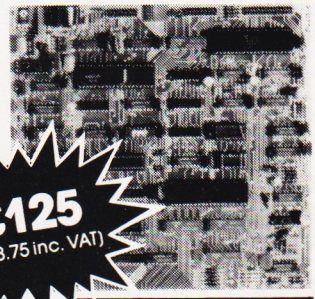
- ★ 4 MHz Z80A CPU
- ★ 64K Dynamic RAM
- ★ RS232 Serial Interface
- ★ Two 8-Bit I/O Ports
- ★ 1200 Baud Cassette Interface
- ★ Extended and Page Addressing Modes

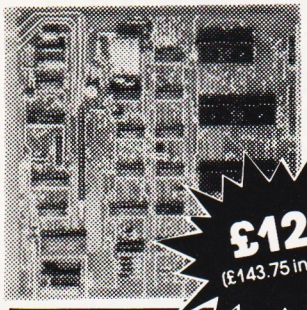
The Gemini GM813 is a new 80-BUS compatible CPU card incorporating 64K dynamic RAM and utilising the powerful Z80A microprocessor running at 4MHz. Extended addressing and page mode facilities allow for future memory expansion up to 2 megabytes. Input and output capabilities include both programmable serial and parallel interfaces — RS232, 1200 baud CUTS cassette interface and the Z80A PIO. When used with the GM812 video card, the GM813's unique RP/M monitor allows the creation of cassette or EPROM based programs or files which are upwards compatible with a disk based CP/M system.

GM811 — CPU Board

- ★ 4MHz Z80A CPU
- ★ Four 'Bytewide' Memory Sockets
- ★ Two 8-Bit Input/Output Ports
- ★ 8 Bit Input Port
- ★ RS232 Serial Interface
- ★ 1200 Baud CUTS Cassette Interface

£125 (£143.75 inc. VAT)





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- ★ 6 I/O Ports
- ★ 4 Counter/Timer Channels
- ★ Real Time Clock
- ★ Further expansion capability

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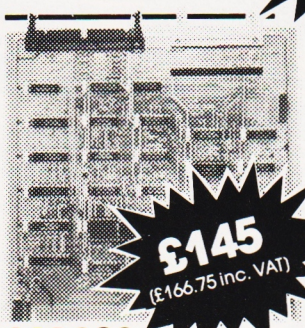

GM812 — IVC Board

- ★ 80x25 Display Format
- ★ On-board Z80A Microprocessor
- ★ Buffered Keyboard Input
- ★ Programmable Character Generator
- ★ 160x75 Pixel Graphics
- ★ Light Pen Input

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- ★ Single/Double density operation
- ★ Single/Double sided drive operation
- ★ Up to 3 mixed 3.5", 5.25" and 8" drives
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- ★ Cost-effective Controller
- ★ Comprehensive software supplied

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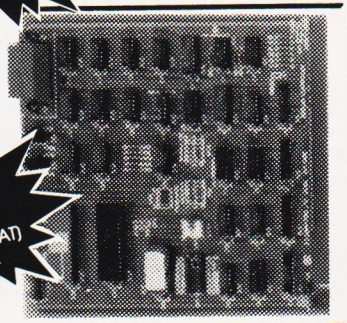

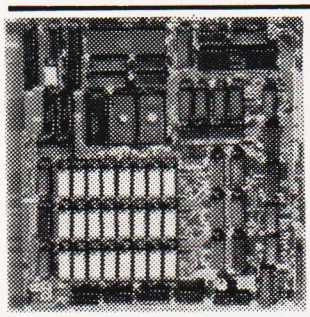

PLUTO — Colour Graphics Processor Board

- ★ 640 x 576 Bit mapped display
- ★ On-board 16-Bit microprocessor
- ★ Comprehensive on-board software

IO 828 A:	IO 828 B:
192K RAM	"BABY PLUTO"
"PLUTO" **£399**	96K **£299**
(£458.85 inc. VAT)	(£343.85 inc. VAT)

Other boards available in the Multiboard range include:

GM802	64K Dynamic RAM Board	**£125** (£143.75 inc. VAT)
GM803	EPROM/ROM Board	**£65** (£74.75 inc. VAT)
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All MultiBoards are Nasbus* compatible
Ask for latest catalogue for full details.

*Trademark of Nascom Microcomputers Division of Lucas Logic

MicroValue

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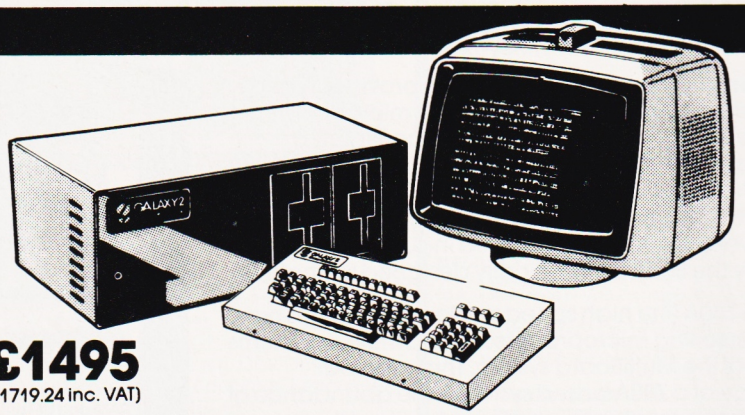
COMPUTERS

New from Gemini

Gemini Galaxy 2

- ★Twin Z80A Processors
- ★CP/M 2.2 Operating System
- ★64K Dynamic RAM
- ★800K Disk Capacity
- ★80x25 Video Display
- ★Serial and parallel printer interfaces
- ★Cassette and light pen interfaces
- ★User definable function keys
- ★Numerical key pad
- ★12" Monitor included

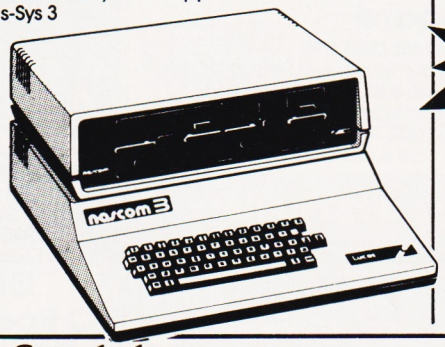


£1495
(£1719.24 inc. VAT)

Total support for Gemini & nascom Products

nascom 3 available from MicroValue

Based around the successful Nascom 2 computer, this new system can be built up into a complete disk based system. Supplied built and tested complete with PSU, Nas-Sys 3 and Nas-Gra.



48K System
£549 (£631.35 inc. VAT)

CP/M 2.2
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NASCOM 2 KIT
£225 (£258.75 inc. VAT)

Built & Tested
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80x25 Video for nascom

NEW LOW PRICE

Nascom owners can now have a professional 80x25 Video display by using the Gemini G812 Intelligent Video Card with on-board Z80A. This card does not occupy system memory space and provides over 50 user controllable functions including prog character set, fully compatible with Gemini G805 and G815/809 Disk Systems. Software supplied on Gemini system disks. Built and tested.

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Nascom 1 Printed Circuit
(inc. parts list)
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GM802 64K RAM Card **£125** (£143.75 inc. VAT)

GM802K 16K RAM Kit **£80** (£92 inc. VAT)

Disk System for Gemini & nascom

GM825 Disk Drive Unit – The GM825 floppy disk housing is supplied with either one or two 5.25" single sided, double density, 96TPI high capacity Micropolis 1015F5 disk drives. These provide 400K bytes of formatted storage per drive. (Gemini QDSS format). The CP/M2.2 package available supports on-screen editing with either the normal Nascom or Gemini IVC screens, parallel or serial printers.
An optional alternative to CP/M is available for Nascom owners wishing to support existing software. Called POLYDOS 4, it includes an editor and assembler and extends the Nascom BASIC to include disk commands.

Single Drive System
GM825-1S
£350 (£402.50 inc. VAT)

Dual Drive System
GM825-2S
£575 (£661.25 inc. VAT)

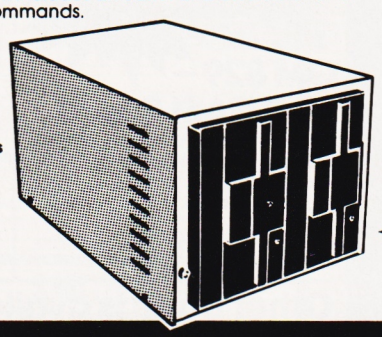
CP/M2.2 Package
(G512 for Gemini)
£90 (£103.50 inc. VAT)

CP/M2.2 Package
(G513 for Nascom)
£100 (£115 inc. VAT)

POLYDOS 4
for Nascom
£90 (£103.50 inc. VAT)

GM809 Disk Controller Card
for 8" and 5.25" drives
£125 (£143.75 inc. VAT)

GM829
for 8", 5.25" and Winchester Drives
£145 (£166.75 inc. VAT)



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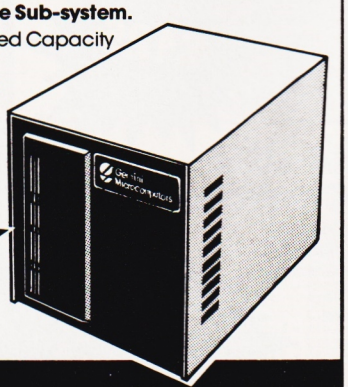
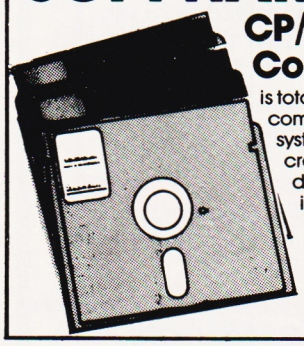
- ★5.4 Megabyte Formatted Capacity
- ★Rodime Drive
- ★Industry Standard SASI interface
- ★Integral Controller and power supply

£1450
(£1667.50 inc VAT)



SOFTWARE



CP/M Software Compas

is totally different from other compiler based Pascal systems, as it allows you to create, edit, run, and debug Pascal programs in a highly interactive manner.

£120
(£138 inc. VAT)

'The Last One' is used in conjunction with Microsoft's MBASIC*. No knowledge of BASIC programming is required since all input is performed using question and answer routines written in plain English.

£330
(£379.50 inc. VAT)

*MBASIC – MicroValue Price if purchased with 'The Last One' **–£178.95 inc.VAT**

VIZ:APL is a high level language system. It can be used to develop small programs faster and large programs in limited memory. The language can be enhanced almost indefinitely and the user's own operators and functions can be built up.

£255
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Gemini Software:

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GEM ZAP Assembler	**£45**	(£51.75 inc. VAT)
GEM DEBUG Debugging Utility	**£30**	(£34.50 inc. VAT)
WORDSTAR Word Processor	**£215**	(£247.25 inc. VAT)
GEM GRAPHIC Links with MBASIC	**£35**	(£40.25 inc. VAT)

A wide range of software for Nascom also available.

When ordering disks, please specify format.

Value - MicroValue - Micro

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★ Sound through TV 5 octaves, 255 tones
★ Advanced Graphics
Full range of Dragon software available.

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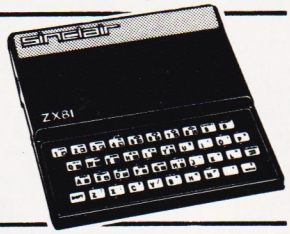
★ 16K ZX RAM PACK	**£26.04**	(£29.95 inc. VAT)
★ ZX81 Learning Lab	**£17.35**	(£19.95 inc. VAT)
★ Software for Sinclair	**from £3.43**	(£3.95 inc. VAT)



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Electronic magnificence from Sharp

Z80A C.P.U. · 48K RAM · 4K ROM · Industry standard Qwerty keyboard with numeric pad · 9" GREEN C.R.T. · 1200 baud cassette · Music and sound · Real time clock · Enhanced BASIC · Full editing facilities · Internal expansion.

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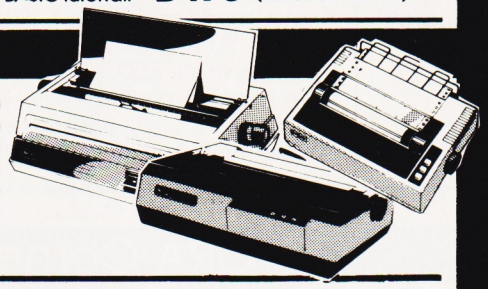
Home budget, bank reconciliation, SPACE INVADERS, STAR TREK, SCRAMBLE, bank loan calculator, mortgage calculator + 7 other games.
Educational—Geography, Maths., Spelling + 4 part BASIC tutorial.

£475 (£546.25 inc. VAT)

PRINTERS



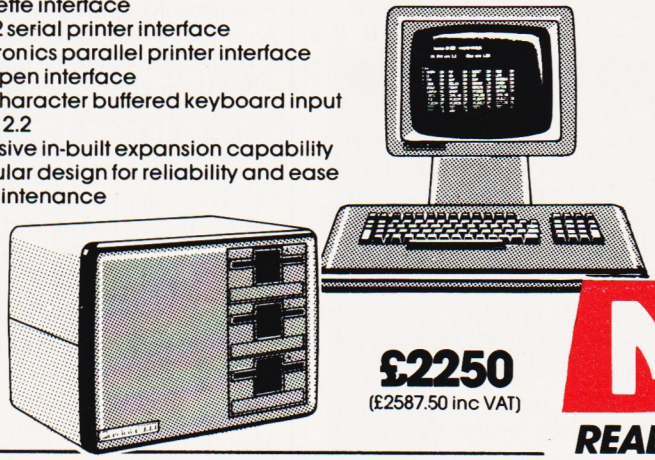
Epson MX80 Type III	**£348**	(£399.95 inc. VAT)
Epson MX80 FT Type III	**£388**	(£445.95 inc. VAT)
Epson MX100 Type III	**£496**	(£569.95 inc. VAT)
NEC 8023A	**£339**	(£389.95 inc. VAT)
SEIKOSHA GP100A	**£215**	(£246.95 inc. VAT)

Daisy Wheel Printer:

Smith-Corona TP-1	**£485**	(£557.75 inc. VAT)

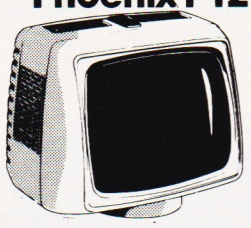
Quantum QM 2000 COMPUTER SYSTEM

* Twin Z80A Microprocessors
* 64K Dynamic RAM
* 2.4 megabytes of formatted disk storage capacity
* 80 × 25 screen format
* 160 × 75 pixel graphics
* Programmable character generator
* Cassette interface
* RS232 serial printer interface
* Centronics parallel printer interface
* Light pen interface
* 128 Character buffered keyboard input
* CP/M 2.2
* Extensive in-built expansion capability
* Modular design for reliability and ease of maintenance



£2250
(£2587.50 inc VAT)

Phoenix P12 Monitor



A high quality data display monitor, ideal for all Nascom and Gemini systems. 20MHz resolution. Available in amber or green phosphor.

£110
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BUSINESS NEWS

BRIGHT NEWS FROM TORCH

Without doubt, Torch are trying to brighten up our lives by announcing a drop in the price of their hardware. The price of the basic Torch Colour Computer with twin 400K floppy disc drives falls from a recommended retail price of £3,499 to £2,795, with equivalent reductions on the more powerful machines. The price of the Z80 Disc Drive Pack for use with the BBC micro also drops from £995 plus VAT to £780 plus VAT. The company has streamlined its production and this has contributed to the price reductions.

Torch are also hoping to lighten the load in many an office in the future with the introduction of their Business Management Package. The system, which has been designed to be simple enough to be used by completely untrained staff, comprises the Torch Microcomputer complete with a range of software to handle all essential office functions. A massive data bank and word processing components are present, together with an accounts system and an extensive card file.

The Torch Microcomputer provides high-resolution full-colour graphics, a complete 'typewriter' keyboard and a built-in communications module providing access to other computers, Prestel and standard telephone lines. The price for the Torch Microcomputer is as already mentioned, £2,795 and the Financial Accounts Package costs £600, but the price for a specific package will depend on the particular requirements. Further details can be obtained from Torch Computers Limited, Abberley House, Great Shelford, Cambridge CB2 5LQ, or 0223-841000.

THE ANDROMEDA STRAIN ▲

If you're into lugging your computer around with you the latest in portable micros has just been announced by IT Computer Services. Called the Andromeda ZITA-P range, there are nine

CRA Corner

As this is the first column which ***Computing Today*** have been kind enough to allocate to the CRA, it is appropriate if I explain some of our aims and objects. The CRA is a voluntary non-profit organisation of leading UK Microcomputer and Software dealers. It was formed about three years ago with three principle objects.

Firstly to improve the standards of trading and customer support within the industry. The CRA feels that in the early days of the microcomputer industry there were far too many dealers who were prepared to sell their hardware but not to go to any great extent in supporting it. Hence, the CRA takes a number of energetic steps to persuade their members to support the products that they sell and specifically are active in investigating complaints from members of the public. The CRA pursue these complaints and in some cases even act as an arbitrator between the parties.

The second object of the Association is to perform a 'Bridging' function between the dealer and the customer. The dealer quite naturally wishes to sell his product. The customer, equally naturally, wishes to get the best value he can for his money. These two aims do not always coincide; the CRA endeavours to provide the needed liaison.

The final object of the CRA is one that does not really affect the public, it acts internally as a forum where members can discuss common problems and exchange ideas with each other.

A new service which the CRA is currently offering to its members is one whereby the latter will be able to obtain free telephonic legal advice on day to day problems.

In summary, the CRA is a body dedicated to maintaining the highest standards in the industry, both from the point of view of the dealers and of the public. From time to time the CRA hold 'mini exhibitions' of various machines. On the 8th February 1983 a new type of exhibition will be held at the Institute of Directors in Pall Mall, London, in that any bona fide member of the microcomputer industry will be more than welcome to attend, without charge. As a matter of fact, non members are also welcome to apply for exhibition space. Unfortunately this show will not be open to the general public.

The CRA is always anxious to receive communications from both the public at large and dealers. Should any reader of this column wish to communicate with the CRA he may do so by writing to:

The Computer Retailers Association,
Molimerx Ltd.,
1 Buckhurst Road,
Bexhill on Sea,
E Sussex;

models in all, the basic unit comprises an integral 10" display, detachable QWERTY keyboard and a single 5¼" disc capable of holding some 125K.

The whole lot is built into an aluminium carrying case and comes at just £995, complete with £995's worth of software. The other models in the range differ only in the size of discs supplied and the facilities offered on the keyboard. Top of the range is the ZITA-4.3 which includes a massive 3M of disc storage, the price of this triple decked system is £3,095.

If you're into Winchester technology drives the ZITA range includes both 6M and 12M versions at £2,595 and £2,895 respectively. All the systems offered by IT Computer Services can be bought outright or loaned from the company. The idea is that you buy the software and they lend you the computer to run it on.

For more information on the Andromeda range of systems or the loan scheme contact IT Computer Services at 173 High Street, Staines, Middlesex.

PICK A CARD

Following the success of the Sirius-80 card, the IBM-80 card for the IBM PC has now hit the market. This add-on card has all the facilities of the Sirius-80 card, re-engineered for the IBM PC. The card runs true CP/M-80 at the full speed of the on-board Z80 processor giving very fast throughput at either 4 or 6 MHz, both versions running code faster than the IBM itself! The card contains 64K of its own RAM and allows the user to access any spare RAM in the IBM as a very fast disc drive. Also included on the card is an interface to the CORVUS range of Winchester disc drives. The prices, excluding VAT, are £299 (4 MHz) and £335 (6 MHz). For further information contact Small Systems Engineering Limited, 2-4 Canfield Place, London NW6 3BT.

EAGLE HAS LANDED ▶

Mediatech are certainly flying high with the first of their new series of 16-bit micros called Eagle 1600. It has all the features of the IBM Personal Computer and is totally hardware and software compatible with that system. The Eagle series uses the 'true' 16-bit Intel 8086 CPU, operating at 8 MHz which greatly increases processing speed. The first Eagle 1600 version, which was introduced at

Compec '82, offers 128K of RAM, a 12.5M hard disc and a single floppy disc drive storing 1M. The price is £5,650 and further details are available from Mediatech, Business Systems, Woodside Place, Alperton, Wembley, Middlesex HA0 1XA, or 'phone 01-903 4372.

PROTECTION RACKET

Microguard has reinforced its Emergency power backup series with the launch of a new product at the top end of their range. The EPU 1000 is a heavy duty unit with 1000 watts output, priced at £695, and it joins the existing range of 200 and 500 watt models already available. Modifications to existing products include faster reaction capability and smoother voltage output. For additional information on the above or on the range of Constant Voltage units, contact Microguard, 24 Foregate Street, Worcester WR1 1DN, or 'phone 0905-21541.

MAGIC! ▲

Well it may not actually be magic, but the Merlin II is a complete re-design of the Merlin I, featuring a larger housing (to accept the optional colour monitor), a more comprehensive keyboard with each key individually re-programmable, and the CP/M disc operating system. Other immediately obvious features are the latest ultra-slim, ultra-fast 'Teac' floppy disc drives and the green phosphor monitor with high contrast non-reflect overlay, and 80 column by 25 line display with true descenders.

Other features include a Z80A processor running at 4 MHz, 64K RAM and 8K ROM (expandable to 32K), 800K twin floppy discs, with a hard disc option, multiple character sets, a fine line graphics set and half tone or reverse video. All the popular software packages are available and the price is less than £2,000. Further details are available from C T Maddison Limited, Eagle Industrial Estate, The Crofts, off Corn Street, Witney, Oxford OX8 7AZ.

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SOFT WARES

BITTEN BY THE BUG

Bug Byte have taken a major step towards their target of becoming the biggest software house in the UK. Laskys, Boots and Currys Micro C are three outlets that have agreed to sell Bug Byte games and negotiations are in hand with two more High Street 'giants'. Having trebled the number of dealers and trade outlets in the past six months, the company seem well on their way to achieving their target of 500 by the summer of 1984.

Software is available for Sinclair, BBC Micro, Acorn and VIC machines and every game comes with a 12 month guarantee against manufacturing defects. A full colour catalogue showing the 40 or more games in the Bug Byte range is available and contains a competition for programmers. Further details can be obtained from Bug Byte Software, 100 The Albany, Old Hall Street, Liverpool L3 9EP.

SHARP PRACTICE

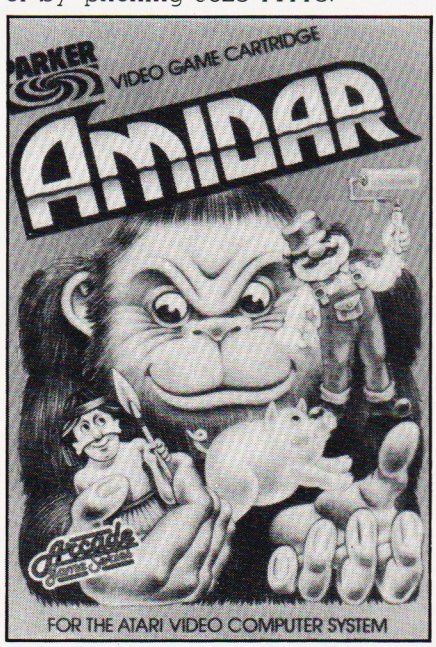
You should keep a sharp lookout for the new Sharp Software Catalogue for the MZ-80A and MZ-80K that's been produced by Kuma. Some highlights are a compiling Pascal, Hisoft Pascal 4, the Bas-Mod toolkit, Calc 3.1 financial modeller and Easy VAT, an accounts program. Sections covered in the catalogue are Applications & Utilities, Languages, FORTH Corner, Educational and Entertainment. With this catalogue the total number of programs for cassette and disc based programs for the MZ-80A and MZ-80K now exceeds 200 titles making this the largest and most prestitious Sharp based software collection in the world. To obtain the catalogue send 50p to Kuma or £1.50 for the previous catalogue (170 programs). These catalogues are free of charge to Company requests and when requested with an order.

Hisoft Pascal 4, mentioned in the above catalogue, is a very fast and powerful Pascal compiler which produces directly executable Z80 object code. Easy to use either in its cassette tape or floppy disc form, it is ideal for a wide range of applications from software development to games writing.

Hisoft conforms to Standard Pascal as set out in the Pascal User and Report with extensions including PEEK, POKE, USER, ADDR, SIZE and INLINE. The prices are: MZ-80K version cassette, £35; MZ-80A version cassette, £35; MZ-80A version disc (CP/M), £40; and MZ-80B version disc (CP/M), £40. The price of the MZ-80B version cassette is to be announced.

Kuma are also responsible for the exclusive distribution of two books: PEEKing and POKEing the MZ-80A and PEEKing and POKEing the MZ-80K, both by G P Ridley. These books contain all the nitty gritty details necessary to get the best out of the Sharp personal computers. This sort of information is not contained in the manufacturer's manual and usually difficult for the first time user to find. The books cost £4.30 each and are available from any good Sharp dealer or direct from Kuma.

Details on any of the above are obtainable from Kuma Computers Limited, 11 York Road, Maidenhead, Berkshire SL6 1SQ, or by 'phoning 0628-71778.



IT'S ONLY A GAME ▲

New on the video game market (and let's face it, we could do with something new!) are two new Atari compatible cartridges — Spiderman and Amidar. For those among you who are not comic strip fans (I assume that are some such creatures), Spiderman has to save the city from his arch enemy, The Goblin. He must throw out webs and climb up skyscrapers and towers to defuse bombs planted by the villain while criminals try to stop him. Featuring realistic sound effects and graphics, the game is for one or two players and accelerates through six levels of difficulty.

Video games players with a sense of the nonsensical will lap up Amidar, a wacky race based on the popular arcade game. Here the players control a gorilla as he moves frantically around a grid, devouring coconuts and avoiding Amidar guards. The next stage requires a good deal of skill as you guide a paint roller around adjacent boxes, painting the grid. If the Amidar guards box you in just press the jump button to make a fast getaway.

Both Spiderman and Amidar retail at £29.95 and are produced by Parker Games, The Pallitoy Company, Owen Street, Coalville, Leicester.

SYSTEMATIC ADVANCES

Producers of business software packages, Systematics International, are intent on becoming market leaders on the IBM Personal Computer and the Sirius I Microcomputer. With this in mind, they have produced a Financial Controller Suite of Programs consisting of: General Ledger, Sales Ledger, Purchase Ledger, Financial Planning, Invoicing, Job Costing, Payroll and Stock Control, with further facets coming. All fully integrated and written in Pascal and running under the UCSD P System, each module can be used as a stand-alone package.

The programs have been on the market since October 1980 and are therefore well tested and fully proven, their main strength being that they are simple to use for the first time computer user. The company have just started a massive campaign to launch Systematics Software to over 300 Sirius and IBM dealers in the UK, following major agreements with Triumph Adler and NEC Telecommunications.

Each package costs £350 and includes a half-day training. Further information may be obtained from Systematics International Microsystems Limited, Cleves' House, Hamlet Road, Haverhill, Suffolk CB9 8EE or 0440-61121.

MASTERING THE KEYBOARD ▲

For those of us who sport permanent blisters on our only two fingers that can regularly hit keys with any semblance of accuracy, help is on the way. Caxton has produced a new teaching method called Touch 'n' Go, designed to turn two fingered tappers into ten fingered keyboard masters in just 24 hours.

Based on most frequently used letters and words, the Harcourt Keyboard Method was developed by the product author, Stan Harcourt, and translated into a screen driven program by his son, Bob. The product is uniquely presented in a 'Pop Record' sleeve on the back of which are written just three simple instructions to get you started.

The program is priced at £25 (excluding VAT) and runs on 48K CP/M and MP/M systems. If you can manage it, you could type a letter to Caxton Software, 10-14 Bedford Street, Covent Garden, London WC2E 9HE for more information, although they will probably welcome hand-written enquiries as well!

ACCOUNTING FOR BUSINESS

Fully Integrated Business Systems announce their new business software, which has been put onto the new Model 16-bit micro from Tandy, and also exists on their Model II TRS-80 eight-bit machine. The software can be supplied on floppy or hard disc. Six models are marketed: Order Entry/Stock Control/Invoicing, Sales Ledger, Purchase Ledger, Nominal Ledger, Work in Progress and Bill of Materials/Parts Explosion.

Each package retails at £500 (excluding VAT) and has one day of a management consultant allowed within this cost to implement software. Each module although fully integrated may be implemented singly as part of a phased development leading to the user's complete accounting system. Write to Fully Integrated Business Systems, 3 Hornton Close, Little Aston, Sutton Coldfield, West Midlands B74 4UT, or 'phone 021-353 7182, for more information.

THE FORTHRIGHT MICRO

A new compiler for FORTH on the BBC A and B micros is now available. 'r q FORTH' is supplied on cassette with a 70 page manual. As the system has been produced specifically for the BBC Micro, it is small enough to fit on the 16K version and yet include a full screen editor and other useful features such as text error messages. r q FORTH is up to 10 times faster than BBC BASIC and follows the FORTH-79 STANDARD, having been designed to include many facilities from fig-FORTH. Priced at £15 inclusive, further details can be obtained by writing to Level 9 Computing, 229 Hughenden Road, High Wycombe, Buckinghamshire HP13 5PG, or 'phoning 0494-26871.

TRY TO BE HUMAN ▲

Yes, the name of the game is Evolution and the aim is to advance up the evolutionary chain from amoeba to man. Written for the Apple, it has 99 levels of difficulty with full sound and graphics effects. The player has to evolve through six distinct steps: amoeba, tadpole, rat, beaver, gorilla and finally man.

Produced by Sydney Development Corporation, the game is to be marketed in the USA and Canada by Computerland, a major computer products retail chain. If you would like more information, including pricing which we were unable to ascertain at the time of going to press, write to the firm's UK subsidiary: Sydney Development Company (UK) Limited, 13 Wilton Place, London SW1X 8RI, or 'phone 01-235 2939.

Chalksoft is a new company in the educational software market, aimed

SOFT TOUCH

mainly at the 5-11 year old group. Programs are available for the BBC 32K and VIC-20 6.5K micros and further plans include versions for the 48K Sinclair Spectrum. The following are currently available. Metrics, at £9.95, is a suite of five interactive colour and sound programs designed to check childrens' knowledge of the Metric system. Invisible Man, at £5.95, draws and labels a Cartesian grid, then hides a cartoon man. Co-ordinates are keyed in, clues and error messages given via sound and visual signals, all aimed to keep the kids on their toes (or rather, their fingertips). Sequences, priced at £5.95, demonstrates seven important number patterns. Angle, costing £6.95 and for the BBC B micro only, is a suite of four programs developing the concept of angle as turning using a fully labelled 360 degrees protractor drawn on the screen. Inkosi is an adventure/simulation game and costs £5.95.

Some reading and writing tapes are in preparation, including Letters (£6.95), Punc-Man, and Reversals, dealing with letter formation, punctuation marks and the problems of letter and number reversal respectively. All cassettes use full colour and sound and can be obtained from Chalksoft, Lowmoor Cottage, Tonedale, Wellington, Somerset TA21 0AL, or 'phone 082-347 7117.

SO YOU THINK YOU CAN WRITE PROGRAMS?

Tell us about it. ASP Software is in the process of expanding its catalogue of products and is looking for programs for the following machines:

TANDY TRS-80: PET: SPECTRUM: VIC-20: DRAGON 32: ATARI 400/800: BBC A/B: SHARP MZ-80K/A: APPLE II and III.

If you have written material for any of these and would like to realise a good commission on your work contact ASP soon. We pay good rates and use our own computing magazines to reach the maximum possible market for your work. (All our authors are credited on the product too).

So don't keep those routines to yourself, they could be worth fame and fortune.

WRITE TO: RON HARRIS, MANAGING EDITOR, ASP SOFTWARE, 145 CHARING CROSS ROAD, LONDON WC2H 0EE.

NEXT MONTH

computing today

MARCH ISSUE ON SALE FEBRUARY 11th

INSTANT TAKE AWAY

Have micro, will travel seems to be the watchword of the industry at the moment. Ever since Adam Osborne challenged the world with his best selling Osborne 1 system more and more manufacturers seem to have been trying to cram the maximum amount of computing power into the smallest and most carryable box. Epson, no stranger to the micro scene through their range of matrix printers, have come up with the emminently portable HX-20 system and our reviewer has been carrying it almost everywhere for the last few weeks. The results of his tests on this extraordinary machine can be found in our next issue so make sure you carry one off!

IT'S IMPOSSIBLE!

Well, you could be forgiven for thinking that PEEKing a screen location on the ZX Spectrum was almost impossible owing to the fact that the screen memory map is more than a little oddly arranged. However, given a little ingenuity and a short, universal subroutine you may well be pleasantly surprised to discover that it is not so hard after all!

You'll have to wait to find out how we do it but the wait will be well worth it if you are into moving graphics and the like.

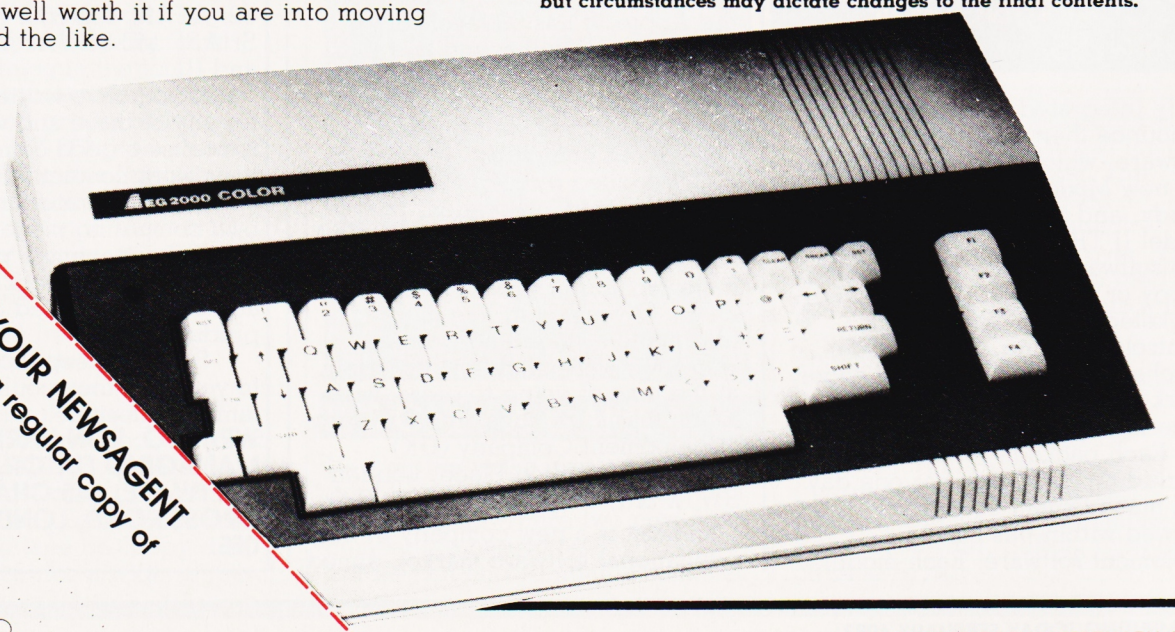
PAINTING BY NUMBERS

Recently launched onto the market is the latest system from Video Genie which, in common with many of today's micros, offers the facility to produce colour graphics. Priced at a shade under £200 it comes into direct competition with systems such as the Dragon 32, the Lynx and the Atari 400. So, just what has it got to offer against this barrage of alternatives? Well, our reviewer has been trying out this digital equivalent of the paintbrush and brings his report into print in next month's issue. So, if you want to find out the real facts about this latest export from the Orient don't miss our March issue!

UNRAVELLING ATARI BASIC

There is a great shortage of useful information on the Atari range of micros and, in an effort to redress the balance our March issue takes a look at the inner workings of the Atari BASIC Interpreter. It's not quite the same as Microsoft so an understanding of the workings can certainly help the enthusiastic programmer who wants to get more out of his BASIC code than usual.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.



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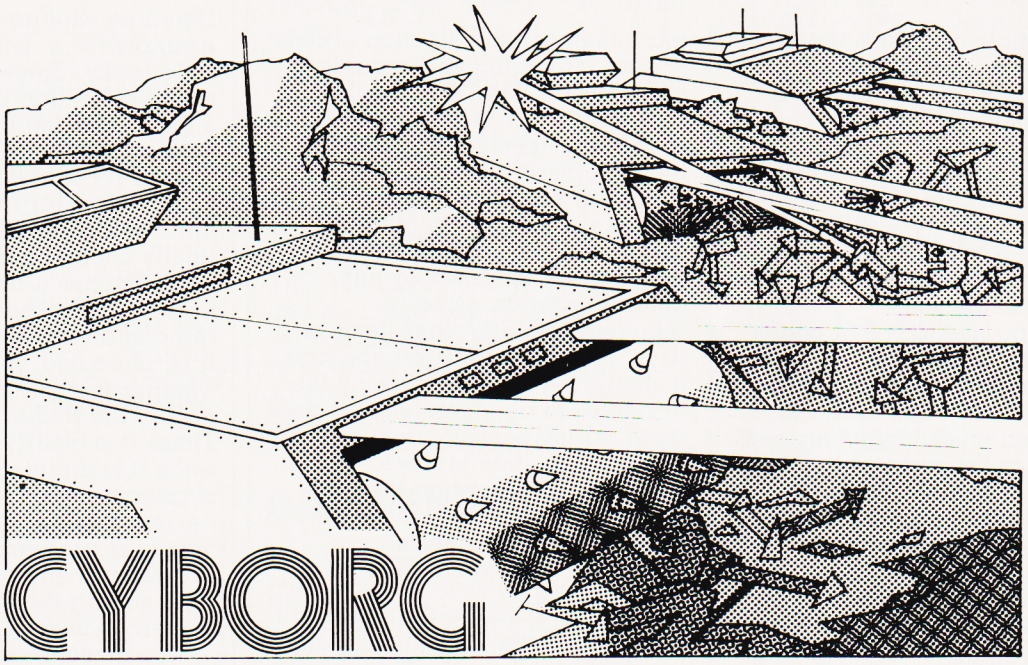

Cyborg is unashamedly an "all the fun of the fair" arcade game. It contains some of the best graphics that we have ever seen for the TRS-80 and supports sound and joysticks.

The scenario of Cyborg is that it is a sport of the future. The player is situated in a massive complex which is split up into 20 smaller complexes. Within these are a number of mad robots dashing around, stationary mines and signal modules. You collect the modules and hopefully destroy the mines and robots before they get you. You can only attack the latter successfully if your force shield is up. If it is down, then the robots will kill you and the mines blow you up. There are 12 signal modules to be retrieved from each complex and as you proceed from one complex to another so the speed of the game becomes faster and faster.

You have the advantage of two scans, a short range and a long range, and as usual with arcade games, success is judged by the number of points which you score. Robots travel at two speeds, the fast ones give you 60 points and the slow 30 points. Mines are worth 100 points and so are the signal modules. Travel throughout the complex is by sled. When and if you reach 20,000 points you will be given an extra sled, up to a maximum of seven. In addition to the above, the player is fighting against time. If he does not achieve the 12 signal modules in his present complex within a set time, which is measured by his bonus score, he will be vaporized.

One to four people can play Cyborg. The sound is of very good arcade type quality and the graphics are quite outstanding. Whilst one is travelling around the complex, of course, the graphics are good, but quite normal, it is in the ancillary parts of the game that the incredibly fast and smooth graphics really come into their own.

Most importantly, Cyborg is an original concept in arcade games and should prove to be a standard by which others are judged.

Cyborg is compatible with TRS-80 Models I and III and the Genie machines. It is available on both tape and disk.

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Garry Marshall

LANGUAGES IN USE

With so many computer languages around it is often difficult to choose the right one for the job. In his new series, Garry Marshall examines a number of tasks that you might solve in BASIC and shows that another language might have made life easier.

This article examines the way in which a small personal data base can be designed and implemented. It is first implemented in BASIC, and although it is possible to establish and examine a data base in a perfectly satisfactory way with BASIC, the reader may agree that certain infelicities exist in the somewhat cumbersome programming methods that one is forced to use. After the development of a data base using BASIC has been described, the way in which other languages can be applied to the same task is examined. Pascal has certain useful attributes particularly when it comes to handling a collection of data as a single entity. It is, however, unfortunate that one of the aspects of Pascal that would be particularly useful in this context is seldom present in the versions of Pascal that are available for microcomputers. This leads us to investigate a different approach to establishing and interrogating a data base which is made possible by using PROLOG.

Hopefully, after reading this article the reader will be in a position to establish a data base for his own personal use in whatever area it might prove of value. Taking it that BASIC is readily available, it can always be used as the implementation language. However, anyone deciding to go in for data base development in a serious way may be persuaded that other computer languages at least have features that make them worth examining as contenders for the language to be used.

WHAT IS A DATA BASE?

Essentially a data base is a large, integrated collection of data. It is also rather more than this because a collection of data is of somewhat limited value unless something can be done with it. The kinds of operations that one is likely to want to perform on data are to update it, to sort it, to search it, and perhaps above all to access or retrieve it. In this way a data base is rather more than just a collection of data: it is an integrated and organised collection of data. It is integrated so that it is stored in such a way as to prevent items being duplicated, thus minimising the storage required, but, most importantly, it is organised in a coherent and structured way so that any item of data can be accessed by any natural criterion using its relationships with other items of data. If this sounds a bit abstruse, it should be made clearer by the examples to be given later. It does seem self-evident, though, that a collection of data is stored in the most logical way when it allows any individual item to be retrieved by exploiting the natural relationship between different items of data.

A program to permit the creation of a data base as well as its interrogation is variously known as a Data Base System and a Data Base Management System. A number of general, and very powerful, programs of this kind are commerically available for microcomputers. Whether for personal or business use a good data base system can be among the most useful of programs. The main problem of a programmer writing a data base system for general use in any of a variety of applications is to make it sufficiently general so that the natural relationships between different items of data can be exposed and exploited to the full in any context. In this article we shall bypass this kind of difficulty, and the expense of a commerical package, by developing a data base system to deal with a fairly simple specific case.

FOR EXAMPLE . . .

Deciding what to use as an example for a data base proved a little tricky. Something like a stamp collection is, in many ways, a good idea but if the idea of collecting stamps is not attractive to you, it could well be that you will read no further. In trying to think of a suitable example, it finally occurred to me that almost everyone has a data base at home in the form of the details of the radio and television programmes. It is, of course, printed, but whether it appears in the daily paper, the **Radio Times** or the **TV Times** it is clearly a data base since it is an integrated collection of data organised so that individual items, usually, but not necessarily, details of programmes, can be accessed in any of a variety of ways suiting the differing needs of numerous users.

To demonstrate the principles involved it is not necessary to take a whole day's programmes, and to keep the example to manageable proportions we will deal with the programmes for one evening in the period from 8.00 pm to at least 10.20 pm as shown in Fig. 1.

The first part of the problem is to decide how to organise and store this information. The basic assemblage of data is clearly all the details of an individual television programme, and the entire collection consists of these assemblages, with one for each

BBC 1	BBC 2	ITV
	7.30 The Children of Theatre Street	
8.00 Dallas		8.00 Starburst
8.45 Points of View		
9.00 News	9.00 MASH	9.00 Strangers
9.25 Whicker's World	9.25 Smiley's People	
10.05 Sportsnight		10.00 News

Fig. 1. The television programmes we will incorporate into our data base.

programme. If we were compiling a card index, then we would have one card containing all the data for one programme, and the card box would be full of such cards. The information about each programme can arguably be arranged under the following headings:

Title
Start time
End time
Channel
Type

If you disagree with this categorisation, amend it and then simply follow through the consequences of the amendments in what follows: it is conceivable that the star of each programme should be listed or that the programme's rating could be given. The way in which a card to be placed in a card box could be laid out is shown in Fig. 2, which shows not only how the card is laid out but also how it is filled in with the details of a specific programme.

TITLE:	Smiley's People
START TIME:	9.25
END TIME:	10.20
CHANNEL:	BBC 2
TYPE.	Drama

Fig. 2. A file card version of the information we wish to store.

DATA STRUCTURING

Before proceeding to write a program to store this information, we ought to check that the way in which we propose to record it permits typical queries to be answered. In other words we should ensure that the data is structured in such a way as to permit it to be retrieved in the ways that users might want to. Typical enquiries about an evening's television programmes might be:

What's on at 8 o'clock?
Is there a programme about science on this evening?
What time is the news on?
What's on now?

These questions can be answered by interrogating the information stored for each programme in the data base: the questions can initially be expressed in pseudo-BASIC. The question 'What's on at 8 o'clock?' — taking it to mean 'Which programme starts at 8 o'clock?' can be answered by testing the record for each programme with:

```
IF Start time = 8.00 THEN PRINT Title
"on" Channel
```

Similarly, the second question can be answered by testing each record with:

```
IF Type = science THEN PRINT Title
"at" Start time "on" Channel
```

The time of the news can be found using:

```
IF Title = news THEN PRINT Start time
```

and we can find what is on now with:

```
IF now >= Start time and now < End
time THEN PRINT Title "on" Channel
```

That the answers to these questions can be found seems to indicate that we could obtain the answer to any reasonable question, thereby showing the design of the data base to be satisfactory. It only remains to implement it.

IMPLEMENTATION

The first thing that our program must do is to store all the information to establish the data base. Preferably, the information should be stored in a way that reflects the manner in which it is organised. Since BASIC's most complex data structure is the array, we shall store it in a series of parallel arrays as shown in Fig.

Start time: S$		Programme 1	Programme 2
		T$(1)	T$(2)
Title:	T$	DALLAS	
		S$(1)	S$(2)
Start time:	S$	8.00	
		E$(1)	E$(2)
End time:	E$	8.45	
		C$(1)	C$(2)
Channel:	C$	BBC 1	
		Y$(1)	Y$(2)
Type:	Y$	SOAP OPERA	

Fig. 3. We can use string arrays to provide the equivalent of a number of file cards.

3. Although some of the data is alphanumeric and some numeric, it is convenient to store all of it in alphanumeric form in string arrays. In this instance it simplifies the problem of displaying times in a form such as 9.00. In general, it introduces a measure of conformity which makes it possible to use a two-dimensional array rather than a series of one-dimensional arrays to store the data should this prove convenient. In any case, the VAL function can always be used to recover numeric values stored as strings in string variables. After declaring the arrays with:

```
10  DIM T$(11),S$(11),E$(11),C$(11),
    Y$(11)
```

the individual items of data can be stored in the arrays with assignments such as:

```
20 T$(1)="DALLAS"
30 S$(1)="8.00"
40 E$(1)="8.45"
50 C$(1)="BBC1"
60 Y$(1)="SOAP OPERA"
```

It is probably much more convenient, however, as well as making the program much more generally applicable, to enter the data interactively. The following lines permit this as well as providing the user with the chance to correct any mistakes made during data entry.

```
20 FOR I=1 TO 11
30 PRINT"ENTER DETAILS OF PROGRAMME ";I
40 INPUT "TITLE"; T$(I)
50 INPUT "START TIME";S$(I)
60 INPUT "END TIME";E$(I)
70 INPUT "CHANNEL";C$(I)
80 INPUT "TYPE";Y$(I)
90 PRINT"[CLS]THE DETAILS OF PROGRAMME
   ";I;" ARE"
100 PRINT
110 PRINT"TITLE:",T$(I)
120 PRINT"START TIME:",T$(I)
130 PRINT"END TIME:",E$(I)
140 PRINT"CHANNEL:",C$(I)
150 PRINT"TYPE:",Y$(I)
160 PRINT
170 PRINT"[REV]PRESS Y TO ACCEPT AND N TO
    REENTER[OFF]"
180 GET A$: IF A$="" THEN 180
190 IF A$="Y" THEN 220
200 IF A$="N" THEN 30
210 GOTO 180
220 NEXT I
```

When all the data is entered it must be stored on some permanent medium either tape or disc, so that there is no need to enter it every time it has to be interrogated. The data can be stored on disc when using a PET by:

```
300  OPEN 2,8,2,"0:PROGS,SEQ,WRITE"
310  FOR I=1 TO 11
320  PRINT#2,T$(I);S$(I);E$(I);
     C$(I);Y$(I);CHR$(13);
330  NEXT I
340  CLOSE 2
```

Once the data is stored it can be interrogated. The first time the program is used the data can be interrogated immediately after it has been entered and saved. On subsequent occasions it should be read from the permanent storage into the arrays before it is examined. One way to perform the interrogation is to add lines to the program as appropriate. To find when the *News* begins on any channel we could add:

```
400  K=0
410  FOR I=1 TO 11
420  IF T$(I)="NEWS" THEN PRINT
     T$(I);" IS AT ";S$(I);" ON ";
     C$(I):K=1
430  NEXT I
440  IF K=0 THEN PRINT "SEARCH
     UNSUCCESSFUL"
```

The variable K is used as a flag to indicate if the query of line 420 is successfully answered at least once. If the query is not answered, a message indicating that the required information is not present in the data base is printed. To find what is being shown at 9.20 on any channel it is only necessary to alter line 420. The new line should be:

```
420  IF (VAL(S$(I))=<9.20) AND (VAL(
     E$(I))>9.20) THEN PRINT T$(I);
     " IS ON ";C$(I)
```

This will find all the programmes that are in progress at 9.20.

INTERACTIVE PROGRAMMING

Since we are interested in developing programs, it is not unreasonable to have to write a line of BASIC each time we want to interrogate the data base. However, the overall program may well be more satisfactory if it accepts enquiries interactively, and if it does it will certainly be much easier for other people, particularly non-programmers, to use. In order that enquires can be dealt with interactively it is necessary to have a fairly simple, standard way of expressing them. This makes it easy to enter the queries and easy for the program to interpret their meaning. If queries are restricted to the form:

What is the { title / start time / end time / channel / type } of the program with { title / start time / end time / channel / type } _____?

then the handling of enquiries can be managed in a fairly straightforward way. The enquirer needs only to indicate three things. These are:

1) The aspect of a programme that is being enquired about.
2) The aspect of a programme that is offered to identify it.
3) The detail of the aspect in 2).

A typical enquiry expressed in this way is:

What is the start time of the programme with title *Dallas*?

Note that enquiries of the form:

What is the title of the programme with title *Dallas*?

contain their own answer and so need not be processed. It can also be noted that enquires such as:

What is the type of the programme with channel ITV?

have several answers.

The query-handling part of the program can be implemented as shown in Listing 1. The relevant section is from line 500 to the end.

Some of the techniques used here are fairly primitive, particularly those that involve swapping arrays around. Although the methods used here are by no means the only way of realising our data base interrogation system, the use of some fairly clumsy techniques is more or less a constraint imposed by BASIC. Although a two-dimensional array could have been used to store the data base, rather than a series of one-dimensional arrays, its use would have led to a certain amount of obscurity in the program. Since the aim is to reveal the ideas behind the creation of a simple data base management system, it seems preferable to resort to rather inefficient techniques rather than to risk obscuring the principles involved.

A complete listing of the program as developed above for establishing, storing and interactively interrogating a data base is given in Listing 1.

PASCAL'S VERSION

Since Pascal has far more extensive capabilities for structuring data than BASIC, its use as a language for implementing a data base system should be investigated. In Pascal, it is possible to create a new variable type in which we can group together all the details that are recorded for each programme. This can be done by declaring a new type in this way:

```
TYPE PROGRAMME = RECORD
   TITLE : ARRAY [1..32] OF CHAR;
   START_TIME, END_TIME : REAL;
   CHANNEL : ARRAY [1..4] OF CHAR;
   TYPE : ARRAY [1..16] OF CHAR
   END
```

Variables of this new type can then be declared and used, thus permitting a collection of data to be manipulated as a single entity. However, in this application the only time that treating all the data relating to one programme as a single entity would really be advantageous is when it is written to or read from tape or disc. Unfortunately, the features that permit these activities are usually not implemented in the versions of Pascal that are available for microcomputers. For this reason we shall not explore the potential of Pascal as a langauge for this application any further, but will examine a different avenue.

There are two basic kinds of data base; formatted and relational. We have just developed a simple example of a formatted data base in which each entry has the same fixed format. In a relational data base all the data is represented in a two-dimensional table having just rows and columns. The data for our example is presented in this way in Fig. 4. One row in the table contains all the information relating to one television programme, while one column contains all the details of one aspect of a programme for every programme in the data base. This type of data base has been much investigated by researchers at IBM. It is also reflected in the 'spread-sheet' layout employed by VisiCalc and similar programs. There is a language available for microcomputers that makes it possible to take a relational approach to data bases, and that is PROLOG.

PROLOG AND DATA BASES

PROLOG is an interactive language in which statements, or clauses as they are known, are processed as they are entered. There are fundamentally only three types of clause. One type presents data which, in essence, PROLOG stores in the form of a table of the sort illustrated in Fig. 4.

An example of a data clause from our present context is, in English:

Dallas starts at 8 o'clock.

This can be expressed in PROLOG as:

```
start_time (dallas, 8.00).
```

The second type of clause gives rules about data and the relationships between them. An example of this, in English, is:

A programme is interesting if it is about science.

In PROLOG this can be written as:

```
interesting (X) : - type (X, science).
```

Here the capital letter X denotes a variable which, when used to represent the title of a programme as in:

```
type (horizon, science).
```

allows the rule to be expressed as 'any programme is interesting if the type of the programme is science'. These two types of clause provide the information to be stored in the data base : the third type is the query clause that is used to interrogate the data base. A query such as:

> Find a programme starting at 9 o'clock.

can be written in PROLOG as:

```
? - start_time (X, 9.00).
```

This instructs PROLOG to find a value for the variable X such that start__time (X, 9.00) matches a given data clause. Again, there can be more than one value for X which is satisfactory.

programme with title X is on now (at time Z) can be written as:

```
on_now (X, Z) : - programme
(X, Y, A, B, C), Z> = Y, Z< A.
```

The commas between the different parts of the right hand side of the clause can be read as 'and'. Consequently, the clause can be read as meaning that 'the programme titled X is on at time Z if the programme titled X which starts at Y and ends at A on channel B, having type C is such that the time Z is greater than or equal to its start time Y and also less than its end time A'. That is to say, if the time now is later than or the same as the programme's start time but before its end.

Figure 5 shows the data clauses and rules that are used to establish the data base. After it has been established, the results of typical queries to find the starting time of a programme, to find programmes of a given type, and to find what is on now are shown in Fig. 6.

Title	Start time	End time	Channel	Type
Dallas	8.00	8.45	BBC 1	Soap Opera
Points of View	8.45	9.00	BBC 1	Opinion
News	9.00	9.25	BBC 1	News
Whicker's World	9.25	10.05	BBC 1	Documentary
Sportsnight	10.05	11.25	BBC 1	Sport
The Children of Theatre Street	7.30	9.00	BBC 2	Documentary
M*A*S*H	9.00	9.25	BBC 2	Comedy
Smiley's People	9.25	10.20	BBC 2	Drama
Starburst	8.00	9.00	ITV	Variety
Strangers	9.00	10.00	ITV	Drama
News	10.00	10.30	ITV	News

Fig. 4 A relational data base consists of a table where each row and column contains data related to other rows or columns.

PROLOGUE TO DALLAS

Having seen how PROLOG allows a data base to be established and then interrogated, we can now proceed to our particular example. The shortest way to enter the data in our case is with a series of data clauses such as:

```
programme (dallas, 8.00, 8.45, bbc1,
soap_opera).
```

This can be read as 'the programme titled **Dallas** starts at 8.00 and finishes at 8.45 on BBC1: it is a soap opera'. Rules to give the start time and so on can be written as:

```
start_time (X, Y) : -
programme (X, Y, A, B, C).
```

This reads as 'the start time of the programme with title X is Y if the programme titled X starts at Y and finishes at A on channel B, and is of type C'. A rule to find if a

SUMMARY AND FURTHER READING

There is a good deal of scope for improving the BASIC program and developing it further. In particular, the interrogation technique can be broadened so more complicated queries can be handled. However, a good deal of programming may then be necessary to determine the meaning of queries. A different approach to data base systems can be adopted by using the programming language PROLOG. This language allows a relational data base to be established and interrogated. The reader can compare the relative merits of the two types of data base as well as the efficacy of the programming languages in each case. Hopefully, it is clear that data bases can be established in any application area just as easily as in the one selected here.

A useful book on databases is **Fundamentals of data base systems** by S M Deen, (Macmillan), 1977. A good tutorial treatment of PROLOG is given in **Programming in PROLOG** by W F Clocksin and C S Mellish, (Springer-Verlag), 1981.

```
programme(dallas, 800, 845, bbc1, soap_opera).
programme(points_of_view, 845, 900, bbc1, opinion).
programme(news, 900, 925, bbc1, news).
programme(whickers_world, 925, 1005, bbc1, documentary).
programme(sportsnight, 1005, 1125, bbc1, sport).
programme(the_children_of_theatre_street, 730, 900, bbc2, documentary).
programme(mash, 900, 925, bbc2, comedy).
programme(smileys_people, 925, 1020, bbc2, drama).
programme(starburst, 800, 900, itv, variety).
programme(strangers, 900, 1000, itv, drama).
programme(news, 1000, 1030, itv, news).
start_time(X, Y):-programme(X, Y, A, B, C).
end_time(X, A):-programme(X, Y, A, B, C).
channel(X, B):-programme(X, Y, A, B, C).
type(X, C):-programme(X, Y, A, B, C).
on_now(X, Z):-programme(X, Y, A, B, C), Z>=Y, Z<A.
```

Fig. 5. Establishing the data base rules in PROLOG.

```
| ?- [progs].

progs consulted   392 words      0.11 sec.

yes
| ?- start_time(dallas, X).

X = 800 ;

no
| ?- type(X, news).

X = news ;

X = news ;

no
| ?- type(Y, sport).

Y = sportsnight ;

no
| ?- type(Z, science).

no
| ?- on_now(X, 915).

X = news ;

X = mash ;

X = strangers ;

no
| ?- on_now(X, 1020).

X = sportsnight ;

X = news ;

no
| ?- h
|    e
|
.
```

Fig. 6. Some typical examples of a data base interrogation using PROLOG.

```
10 DIM T$(11), S$(11), E$(11), C$(11), Y$(11)
20 FOR I=1 TO 11
30 PRINT"ENTER DETAILS OF PROGRAMME ";I
40 INPUT "TITLE"; T$(I)
50 INPUT "START TIME";S$(I)
60 INPUT "END TIME";E$(I)
70 INPUT "CHANNEL";C$(I)
80 INPUT "TYPE";Y$(I)
90 PRINT"[CLS]THE DETAILS OF PROGRAMME ";I;" ARE"
100 PRINT
110 PRINT"TITLE:",T$(I)
120 PRINT"START TIME:",T$(I)
130 PRINT"END TIME:",E$(I)
140 PRINT"CHANNEL:",C$(I)
150 PRINT"TYPE:",Y$(I)
160 PRINT
170 PRINT"[REV]PRESS Y TO ACCEPT AND N TO
    REENTER[OFF]"
180 GET A$: IF A$="" THEN 180
190 IF A$="Y" THEN 220
200 IF A$="N" THEN 30
210 GOTO 180
220 NEXT I
300 OPEN 2,8,2,"0:PROGS,SEQ,WRITE"
310 FOR I=1 TO 11
320 PRINT#2,T$(I);S$(I);E$(I);C$(I);Y$(I);CHR$(13);
330 NEXT I
340 CLOSE 2
500 DIM R$(5), X$(11), Z$(11)
510 R$(1)="TITLE": R$(2)="START TIME"
520 R$(3)="END TIME": R$(4)="CHANNEL"
530 R$(5)="TYPE"
540 PRINT"TO ENTER A QUERY USE THE CODE"
550 PRINT"1 - TITLE"
560 PRINT"2 - START TIME"
570 PRINT"3 - END TIME"
580 PRINT"4 - CHANNEL"
590 PRINT"5 - TYPE"
600 PRINT"QUERIES OF THE FORM"
610 PRINT"            1                    1"
620 PRINT"            2                    2"
630 PRINT"WHAT IS THE 3 OF THE PROGRAM WITH 3 --?"
640 PRINT"            4                    4"
650 PRINT"            5                    5"
660 PRINT"ARE ASKED BY ENTERING"
670 PRINT"1. THE CODE FOOR THE ASPECT REQUIRED"
680 PRINT"2. THE CODE FOR THE ASPECT OFFERED"
690 PRINT"3. THE DETAILS OF TTHE ASPECT OFFERED"
700 INPUT M,N,B$
710 PRINT"[REV]SEARCHING[OFF]"
720 IF M=N THENPRINT""B$;" IS THE ";R$(M);" OF THE
    PROGRAM WITH ";R$(N);" ";B$
730 FOR I=1 TO 11
740 IF M=1 THEN X$(I)=T$(I)
750 IF M=2 THEN X$(I)=S$(I)
760 IF M=3 THEN X$(I)=E$(I)
770 IF M=4 THEN X$(I)=C$(I)
780 IF M=5 THEN X$(I)=Y$(I)
790 IF N=1 THEN Z$(I)=T$(I)
800 IF N=2 THEN Z$(I)=S$(I)
810 IF N=3 THEN Z$(I)=E$(I)
820 IF N=4 THEN Z$(I)=C$(I)
830 IF N=5 THEN Z$(I)=Y$(I)
840 NEXT I
850 K=0
860 FOR I=1 TO 11
870 IF Z$(I)=B$ THEN PRINT"[CLS]";X$(I);" IS THE ";
    R$(M);" OF THE PROGRAM"
875 IF Z$(I)=B$ THEN PRINT" WITH ";
    R$(N);" ";B$: K=1
880 NEXT I
890 IF K=0 THEN PRINT"[REV]NO SUCH
    PROGRAMME[OFF]"
900 PRINT: PRINT"[REV]PRESS ANY KEY FOR FURTHER
    INTERROGATION[OFF]"
910 GET C$: IF C$="" THEN 910
920 GOTO 540
```

Listing 1. The complete data base program implemented in BASIC.

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COMPETITION RESULTS

There's no doubt about it — these competitions are as much fun for us as they are to all you dedicated ***Computing Today*** readers, at least judging by the response to the November puzzle! If you were one of those 'game' people who had the talent, patience and nerve to enter the November competition, then read on. In order to save you rifling through all your no-doubt neatly filed copies of ***Computing Today***, I will remind you of the puzzle.

Six anagrams had to be converted to well known computer books and their authors:

MEMORY TIGHT HIC; CARTER KIDDY; SHIP HAS RENT COVER; PETE HATED LEVER; SHARP CHIN MIKE; CHEW ON THE FAMOUS ALIEN.

The initials of the authors' surnames should then have yielded ASCII code values, which should have been added together and converted to a binary number. The correct book titles and authors were as follows:

THE MIGHTY MICRO by CHRISTOPHER EVANS;
THE PET REVEALED by NICK HAMPSHIRE;
THE SOUL OF A NEW MACHINE by TRACY KIDDER.

The total ASCII code value for the initials is 216 and this gives a binary result of 11011000.
The following 15 entrants were the first correct replies out of the Editor's infamous ten-gallon hat: N Jackson (near Oldham), C J Burden (Frampton Cotterell), P J Connolly (Glasgow), G Blakemore (Loughborough), R B Pigney (near Lincoln), G Smyth (Londonderry), L Evans (New Quay), R J Baker (Congleton), M Gerli (Dulwich), G Robinson (Oxon), M Johnson (Herne Hill), J M Roberts (Durham), H Mallinson (Liverpool), H Yates (Manchester), and J Broadley (Rochdale).
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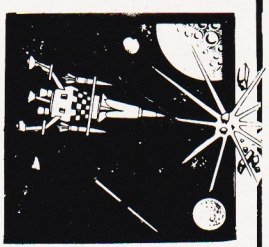

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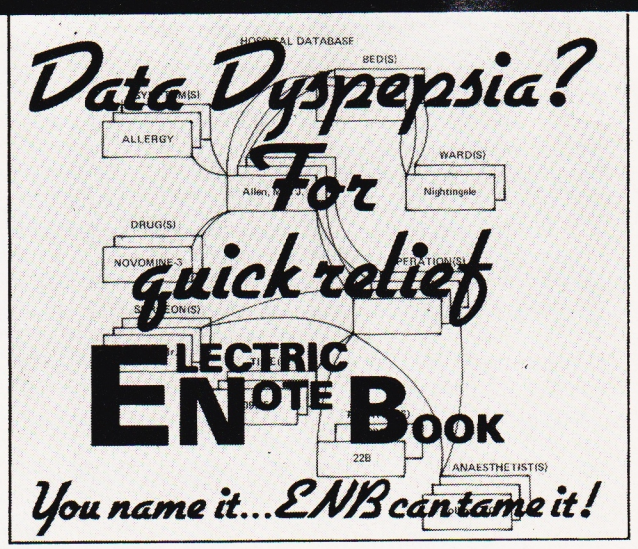

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SECOND HELPING

With the second series of the BBC's Computer Programme receiving its first transmissions this week we take a look at what is in the programmes and how they have been made.

Left: Producer David Allen discusses some finer points with Ian McNaught-Davis and Ian Trackman.
Right: The people you never normally see, the production team, enjoying a break in the recording studios.

If you thought that the BBC's effort at computer literacy was a strictly one-off affair then you were sadly mistaken! Just started this week and due to carry on with three showings per week for 10 weeks, is the second series of *The Computer Programme*. Titled *Making The Most Of The Micro* it is intended to take the next step forward from the previous series. Where the original set of programmes discussed the fundamental ideas behind computing and attempted, successfully too, to introduce these concepts to the naive audience the new series is targeted directly at micro owners and the technically aware.

FINDING THE VIEWER

Volumes have been written concerning the aims and achievements of the first series of *The Computer Programme,* indeed many pages of material have appeared in this magazine on the subject, and much research has been undertaken to find out just who watched it and why. The results of this analysis were sufficiently encouraging for the BBC to confirm their intentions to produce a second series aimed at both the viewer who had watched and understood the first series and the micro owner in general — the two are not necessarily synonymous!

The success of the series abroad has been nothing short of phenomenal. The target figure for sales over the entire year was met in a single trip to the USA where some 100 complete sets of the series have been sold to TV and cable companies as well as other interested parties. Other parts of the Commonwealth appear equally interested and even our Common Market partners seem to want to get in on the act. At a recent conference in West Germany the series producer, David Allen (Project Editor on the first series) discovered that the BBC Computer Literacy project was far and away the most ambitious such undertaking from any EEC country. Even the French, whose similar project appears to have floundered, have expressed particular interest although whether this will be extended to taking the series itself or even the computer is, as yet, unknown.

So, where the first series was breaking totally new ground and involved not just the production of a 10-part TV series but the development and introduction of a new computer as well as the writing of software and several books the second series will be working with an established base. This time around, however, the viewer will find that the information comes at a much faster pace and is of a more technical nature. There is, of course, no real need to actually have a computer in front of you to appreciate the programmes, television is designed to be watched after all, but those who do own micros will find much to interest them. We've detailed the theme of each program later on in this article, the information is as correct as possible given that at the time of writing only Programmes 1 to 3 had been filmed and of these only the first two were in any sort of final form. Ideas are being kept flexible, even up to the day of rehearsal, and this is assisted by the fact that the BBC team are using one of their own micros as a word processor and altering the scripts as and when necessary. Indeed, this willingness to adapt and improve is one of the many strengths that the production team has inherited from the previous series. Many of the names that drift up in the final credits will be familiar although Paul Kriwaczek is noticeable by his absence, he's currently involved with a series on biotechnology and another on the history of the orchestra.

While it is almost impossible to define an average potential viewer for the series one of the strongest pointers to the wide appeal that it has is the reaction of people in the studios. During breaks in recording you find camera operators and autocue ladies, stills photographers and countless other people watching the replays or actually asking questions about certain aspects of what is going on. Many of the crew seem to own computers of one sort or another, ▶

and quite apart from its starring role in the production the machine is used for many tasks in the studio itself. Apart from the previously mentioned word processing function the machine is being used as a captioning system, all the captions and credits in the series are generated by the BBC Micro itself, it has actually proved so successful at this task that it will soon be sold as a commercial captioning system for other TV companies to use!

BREEDING SUCCESS

They say that if you find a successful formula you should stick with it and the BBC appear to believe in this. The first series was co-hosted by Chris Searle and Ian McNaught-Davis with the former taking the role of the layman and the latter providing the expert knowledge. In the second series the target audience is assumed to be over the beginner stage and so we have a single presenter in the form of Ian McNaught-Davis who is backed up by a team of experts including Ian Trackman and John Coll.

The ideas behind each programme and the programming concepts that the presenters endeavour to impart follow much the same format as the first series with location reports being followed by studio sequences demonstrating the ideas being turned into code. The BBC Micro takes a starring role at this point and the reason that it is being used as opposed to any other system is simply that it allows good, clear programming techniques to be displayed; long variable names, procedures etc, and the system will produce a broadcast quality picture which can be directly input to the studio equipment. The concepts behind the program examples should be clear enough to allow them to be implemented on any other machine, although it would be nice to see some accompanying notes produced this time rather than just cassettes of the programs from the programmes.

Commercially the previous series was a great success; apart from the foreign sales of the series itself the BBC Micro is now well established after a somewhat rocky start and the two books produced in conjunction with the series were both high in the best seller lists for a time. This time around there will be no new book but the ideas introduced in the series will be made available in the form of programs such as the data base package from Programme 5 and the music composer from Programme 10. The Control Pack from Programme 8 will be made available too and will form the basis of a further National Extension College course in Control Programming.

FORWARD PLANNING

Given that the second series hits its target audience, once again the timings seem to be devised to ensure that only the committed micro enthusiast will actually get to watch it (schools excepted of course) the Computer Literacy project is not intended to end yet! Plans are already afoot for a third series of ***The Computer Programme*** based on the use of the micro as a control tool, the emphasis here would seem to be on showing how the micro can help both in industry and at home. There are also indications that a separate series on the actual users of micros is being planned and this is likely to appear during late '83. Sources within the BBC suggest that the programmes will be in a magazine format, possibly with active participation by micro users but as is often the case things may change!

MAKING THE MOST OF THE MICRO

1

First Transmission:
Monday January 10th BBC2 15:05
Second Transmission:
Monday January 10th BBC1 23:25*
Repeated:
Sunday January 16th BBC1 12:35
*(This time slot is only approximate)

Aptly entitled *The Versatile Micro,* this first programme introduces the series neatly by outlining the major components and applications of the micro today. As a lead in, we meet Richard Gomm, a cerebral palsy sufferer, who gives some examples of how the micro has changed his life, or at least has made it a lot easier. From using his micro purely as a word processor, he has learnt a variety of more interesting uses including playing games and controlling his environment.

Ian McNaught-Davis and John Coll then show us the main components of any self respecting micro and how they fit together, including a colour display monitor, cassette and disc drives and printer. Mac then gets 'brought down to size' and takes us through the inner workings of the computer, comparing today's machines with those of yesterday, paper tape, valves and all!

2

First Transmission:
Monday January 17th BBC2 15:05
Second Transmission:
Monday January 17th BBC1 23:25
Repeated:
Sunday January 23rd BBC1 12:35

The second programme, called *Getting Down To BASIC,* introduces the fundamentals of programming.

Using elementary multiplication by schoolchildren as the example, the programme introduces us to the three program structures of sequencing, branching and loops. Mac writes a simple sequence of BASIC commands to answer a multiplication question, then introduces a branch in the sequence depending on whether the answer is correct or not. In keeping with the parallel classroom example, he then writes a loop into the program so that all 25 children in the class can be asked similar

Photo: Mike Cocker

questions and given the same number of chances to get the answer right.

We also see the children themselves playing with a micro in the classroom and hear their views on its value (both for learning and for fun).

3

First Transmission:
Monday January 24th BBC2 15:05
Second Transmission:
Monday January 24th BBC1 23:25
Repeated:
Sunday January 30th BBC1 12:35

After dealing with numeric variables in the previous programme, we now take a look at character strings. Various BASIC commands for dealing with character variables are demonstrated, and from there we are introduced to word processing functions. The value of the printer is also discussed. As an extension from the second programme where only very simple command functions were dealt with, this episode is entitled *Strings and Things.*

4

First Transmission:
Monday January 31st BBC2 15:05
Second Transmission:
Monday January 31st BBC1 23:25
Repeated:
Sunday February 6th BBC1 12:35

This programme is intended as an introduction to the graphics capabilities of the micro. We take a look at the resolution of various machines and how the graphics display facilities are useful in diverse fields of interest. Since research has shown that this is one of the most interesting aspects of micros for the public, this episode will undoubtedly be awaited eagerly.

5

First Transmission:
Monday February 7th BBC2 15:05
Second Transmission:
Monday February 7th BBC1 23:25
Repeated:
Sunday February 13th BBC1 12:35

The way in which data is manipulated and stored is of obvious interest and in this programme we learn about data bases. And of course once we have structured the data and develop a particular type of data base, we have to make sure that we can actually retrieve the information we want in the form that we want it!

And for those of you totally unfamiliar with data base terminology, all will be revealed as you continue to watch this episode.

Photo: Robin Mudge

Mac gets to meet Marvin at last!

6

First Transmission:
Monday February 14th BBC2 15:05
Second Transmission:
Monday February 14th BBC1 23:25
Repeated:
Sunday February 20th BBC1 12:35

For all 'progressive' businessmen out there, this one's for you! An examining eye is cast over the rapidly growing field of 'off-the-shelf' business packages that are currently available, eg VisiCalc. The problems that can face the businessman who wants and tries to write his own specific piece of software are considered along with the needs for doing this.

7

First Transmission:
Monday February 21st BBC2 15:05
Second Transmission:
Monday February 21st BBC1 23:25
Repeated:
Sunday February 27th BBC1 12:35

As it was in the first *BBC Computer Programme* series, so it still is today . . . Of course we refer to what is still one of the hottest research areas — Artificial Intelligence, and its allied subject, the Expert System.

This programme takes a look at this subject of eternal interest, together with languages other than BASIC. We can also take a look (or rather, listen!) at speech recognition and synthesis.

Photo: Robin Mudge

On location at Bruce Banks Sails.

8

First Transmission:
Monday February 28th BBC2 15:05
Second Transmission:
Monday February 28th BBC1 23:25
Repeated:
Sunday March 6th BBC1 12.35

The eighth programme takes us for a close look at the control abilities of micros. The example of using your micro to control temperature that was cited in the previous BBC series is now examined in closer detail, and we find out exactly how the micro exercises such control!

It is hoped that the BBC Control Pack will be shown in this episode.

9

First Transmission:
Monday March 7th BBC2 15:05
Second Transmission:
Monday March 7th BBC1 23:25
Repeated:
Sunday March 13th BBC1 12:35

As a follow up and extension to programme four, we are now treated to more information on the graphics capabilites of the micro. A variety of more advanced graphics functions are examined including the possibilities for animation, and colour switching. With the example of Clarks shoe design, we also look closely at Computer Aided Design, and even get to see a special product being produced for Mac.

10

First Transmission:
Monday March 14th BBC2 15:05
Second Transmission:
Monday March 14th BBC1 23:25
Repeated:
Sunday March 20th BBC1 12:35

In the final programme we look at the role of micros in music and communications. An introduction to networking is given and the various systems already in use such as Teletext, Dialcom and electronic mail are considered.

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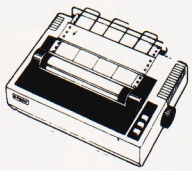

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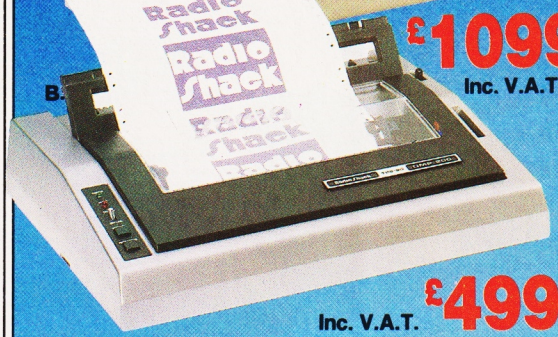

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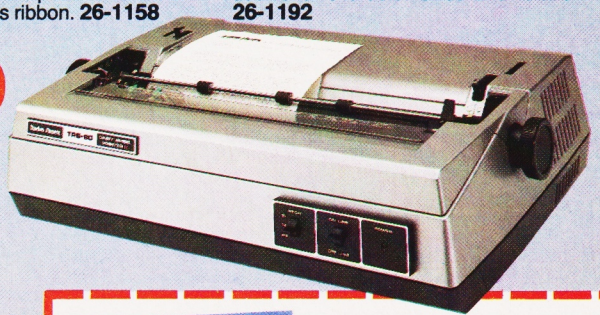

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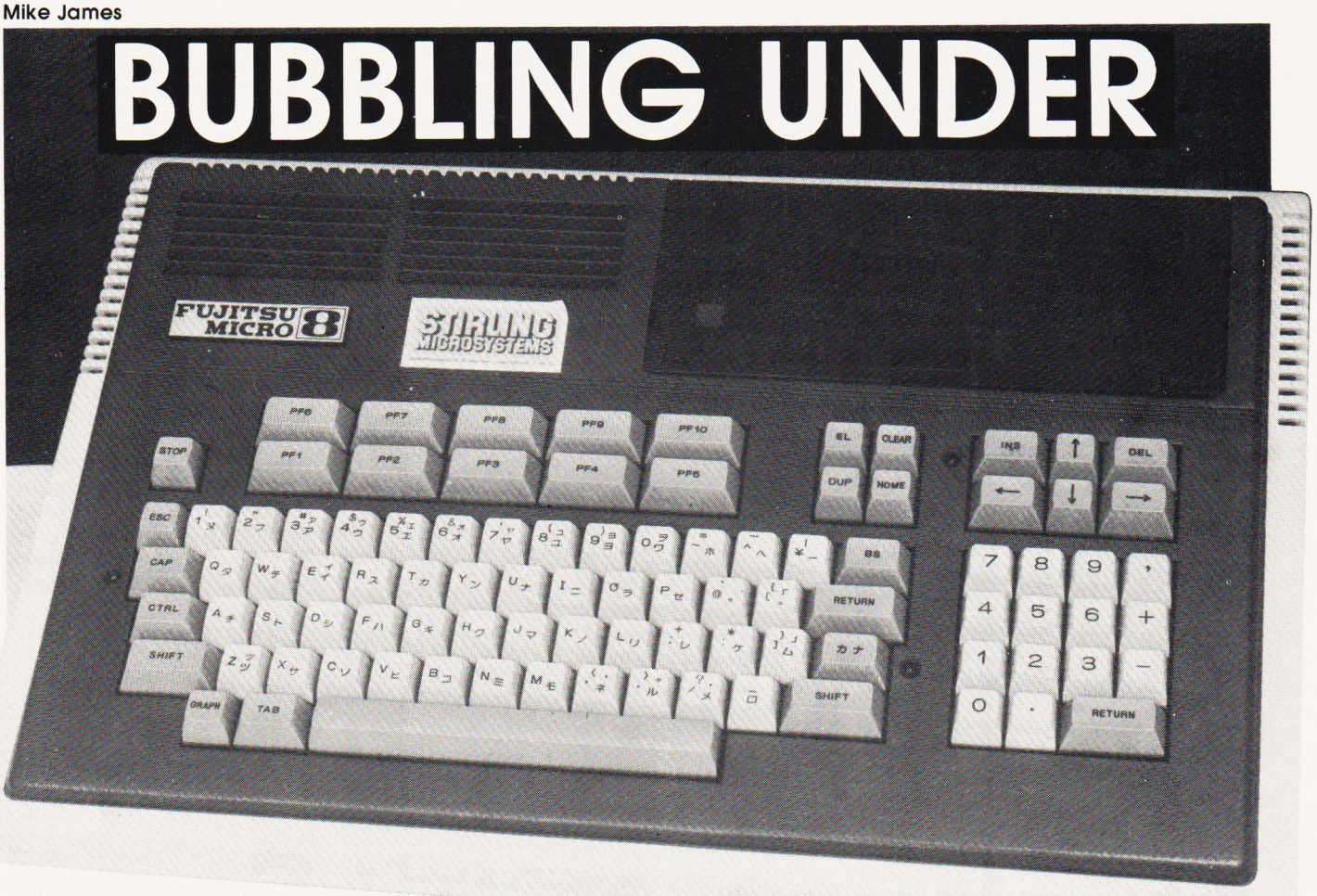


Equipping a personal computer with twin processors and the ability to accept bubble memory cartridges might seem to be an overkill approach. Fujitsu, however, appear to have justified the extravagance with their FM-8.

The Fujitsu FM-8 is one of the few Japanese micros which is already available in the UK. Actually, Fujitsu haven't officially released the machine in this country yet, but a number of importers are offering it. The reason for this is that it is a very remarkable computer and not only gives some idea of what is waiting in the wings — remember, there are a great many alternative models vying with each other in Japan — but is has some interesting facilities in its own right.

OVERVIEW

The Fujitsu FM-8 is an impressive machine. The unexpanded model (the subject of this review) occupies a single case which includes the keyboard and electronics — no disc drives, no monitor (these are available as separate units). This makes the FM-8 sound as if it was in the VIC or ZX Spectrum class of machines built into keyboard units. However, this ignores the fact that the FM-8 is fairly large and heavy — it measures 19″ by 13″ by 5″ and weighs 16 pounds.

This is a big computer in more senses than one (as will be come apparent as the review progresses). The keyboard is a full sized QWERTY keyboard with 56 typewriter keys, four cursor control keys, seven editing keys, 15 numeric entry keys and 10 programmable function keys. With a total of 95 keys in many colours, the keyboard seems very large indeed! As well as the usual Roman letters, each key carries at least one Japanese character which also adds to its complex appearance. However, the keyboard feels good in use and, if you ignore the Japanese characters, is easy to use. Various shift keys can be used to switch between upper and lower case and a range of *'katakana'* characters, which each represent a Japanese syllable. The editing functions are limited by comparison with other systems but are adequate. You can insert in the middle of a line, delete a line and copy part of an existing line to a line being typed. One nice touch is the way the two rows of programmable keys are set to default to useful commands such as LIST and RUN.

Although a special monitor is available for use with the FM-8, the review model performed very well with a range of standard monitors and one converted TV set! The screen can display both text and graphics. There are two text formats: a standard 24 by 80 and a 24 by 40 for use with a UHF modulator and a domestic TV set. A UHF modulator is available as a separate and external unit, but one wasn't used during the review so I can make no comment on how well it performs. The graphics screen boasts very high resolution, 640 by 200 points in eight colours. The use of colour is free of any restrictions and any point can be any colour.

The cassette system is the standard method of data and program storage on the unexpanded unit and is fairly straightforward. Its only notable feature is that it is a little faster than usual — ie 1,600 baud. ▶

One of the expansion features which makes its presence felt even in the unexpanded unit is the bubble memory slot — yes, I did say 'bubble', of which more later. In the top right-hand edge of the machine is a recess covered by a plastic door. In the same compartment you will find the on/off switch but nothing else. If you're not planning to use bubble memory then I suppose you could store small cables, etc, in it!

Overall, the Fujitsu FM-8 gives the impression of a very high quality product. It is heavy enough to stay put on a table while you type and it is large enough to make anyone believe that you are using a real computer!

HARDWARE

The FM-8 isn't a Japanese copy of any other machine. From the hardware point of view it is unique. Superficially, its specification makes it sound like a cross between the Dragon 32 and the Sirius — ie it uses a 6809 and it boasts 128K of memory. However, if you read the small print you will find that it uses a total of three microprocessors and has the option of increasing the count to four! The FM-8 contains two 6809s, one of which acts as the main processor and is responsible for running programs, etc, and the other is a display processor which takes care of the video display. The third processor is a little four-bit device (8841) which takes care of keyboard scanning. The optional processor is a Z80 card which can take over the main 6809's address space. It is the use of two 6809s, rather than moving to true 16-bit architecture, that gives the FM-8 its 128K of memory addressing space. The 6809 is a very advanced eight-/16-bit device ie it is a 16-bit device internally but an eight-bit device externally. Thus, 64K of the address space is available to user programs and the second 64K is dedicated to display and other tasks. This is very sensible! Many a machine which has a large memory capacity ends up dividing its single memory space into such regions and having to look after both with one processor.

Interprocessor communication is a difficult problem that the FM-8 solves by the traditional method of providing an area (128 bytes) of common memory which can both read and write. Although this is traditional, it is more than adequate for processors running at roughly the same speed.

Inside the case, there are more surprises waiting. A large torodial transformer sits astride the single PCB which contains all the electronics. This large transformer is responsible for most of the weight of the FM-8 and could have been eliminated by using a switch mode power supply. Instead, a very reliable but old fashioned rectifier/regulator power supply has been used.

As mentioned, all of the electronics is contained on a single large PCB. The thing that is amazing about this board is not only its size, 16" by 11", but the total number of chips on it — over 200 of them. (Exporting FM-8s should account for a large proportion of Japanese IC production!) The main RAM is provided by a row of eight 64Kbit dynamic RAM chips. This shares the same address space as four ROMs totalling 32K and containing BASIC. The BASIC ROMs can be switched out to give a full 64K to applications programs. In the same address space is a 2K ROM which acts as a bootstrap to get the system up and running.

As has been already mentioned, the video display section has its own 64K of address space which is filled by 48K of video RAM provided by 24 16K dynamic RAM chips. This 48K is treated by the second 6809 as three 16K blocks. The first block corresponds to the blue dots, the second the red dots and the third holds the green dots. By setting combinations of bits in each block, eight colours (see Table 1) can be produced.

Code	Colour
0	Black
1	Blue
2	Red
3	Purple
4	Green
5	Light blue
6	Yellow
7	White

Table 1. The colour codes for the FM-8.

In addition to the 84K of screen memory, the second 6809 has 4K of working RAM and 8K of ROM control program. As if all this memory wasn't enough, there is room for 16 additional ROMs containing alternative character sets. If they were all installed, the FM-8 would have a character set consisting of over 8,500 characters! However, if you use the standard ROMs, around 8,000 of these are the Chinese derived *kanji* characters!

Other pieces of standard hardware on the PCB include a Centronics type parallel port, an RS232 serial interface and a four channel A to D converter. There is also an interrupt timer which is particularly easy to use from BASIC.

The standard of construction of the FM-8 is very high indeed and it should prove to be a very reliable unit. After all, the Japanese use a large number of them and can there be any better sign of confidence?

SOFTWARE

The unexpanded FM-8 is a BASIC machine. To be more specific, it runs an extended Microsoft BASIC which is referred to as F-BASIC. The fact that it is contained in 32K of ROM should give you some idea of how extended it is — most versions of Microsoft BASIC fit into about 16K. Although it has lots of extra features, F-BASIC is not exceptionally fast as Table 2 indicates.

Benchmark	Time
Test 1	1.8
Test 2	6.5
Test 3	17.2
Test 4	16.4
Test 5	17.5
Test 6	29.1
Test 7	49.5
Test 8	6.0

Table 2. Results of Benchmark tests.

A complete Fujitsu system showing off its graphics capabilities.

There are several very interesting innovations to be found in F-BASIC which almost make the FM-8 worth having for the software alone! All of the standard features of Microsoft BASIC are present so there should be no problem in transferring BASIC programs to the FM-8. Integer, single and double precision numbers are present. Also, the string handling functions RIGHT$, LEFT$ and MID$, extended statements such as WHILE, IF... THEN... ELSE, and the usual file handling statements are all present. In other words, you need not have any worry that F-BASIC is non-standard, it *is* Microsoft BASIC.

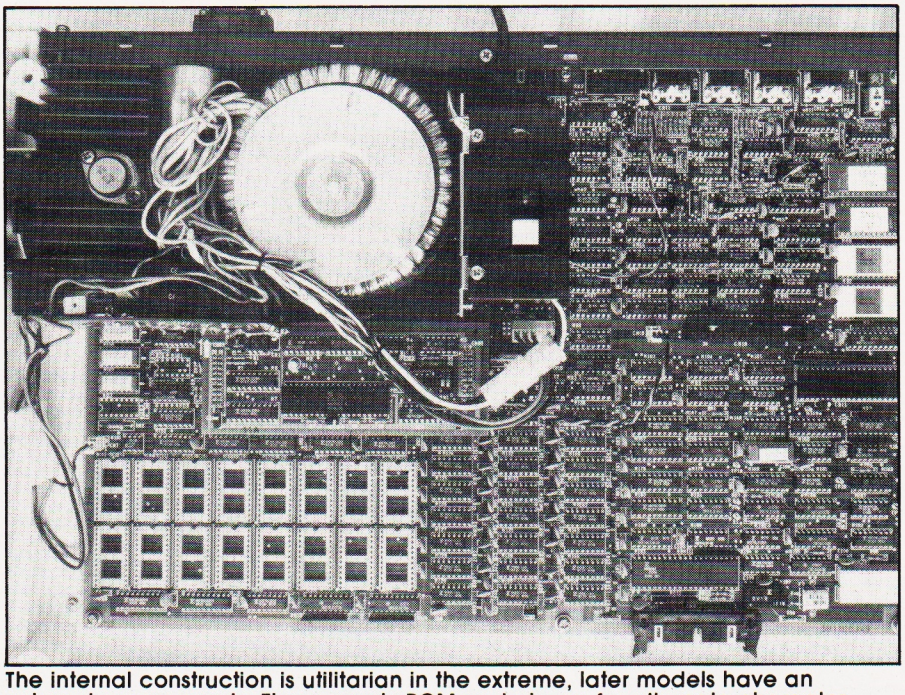
The extensions to Microsoft BASIC which make F-BASIC different fall into two areas — graphics commands and extra I/O commands. The commands which control the high resolution screen include familiar statements such as RSET (set a point to a foreground colour), PRSET (reset a point to a background colour), CONNECT (draw a line between any number of points), CIRCLE (draws a circle of specified radius) and PAINT (fill an enclosed area with a specified colour). It is possible that all of these commands crop up under sightly different names in other dialects of BASIC.

One that I would like to see added to other BASICs is the SYMBOL command. This will display any string of characters at any position on the screen and with any orientation and any size. In other words, you can print messages on the screen from top to bottom, bottom to top, and at any angle in large or small letters. As you can imagine this is very useful for labelling graphs or for printing Japanese down the screen! This summary should indicate that the graphics facilities of F-BASIC are equal to most.

WHAT'S THE DIFFERENCE

The thing that makes F-BASIC different is that it is the first full version of BASIC (that I know of) which recognises that interrupts exist! Interrupts are usually the province of assembly language programmers only but, as F-BASIC proves, they can easily be incorporated into a high level language such as BASIC. The best way to explain the idea of interrupts without getting involved in some hardware theory is simply to give an example F-BASIC program.

```
10  PRINT TIME;" START"
20  ON INTERVAL GOSUB 1000
30  INTERVAL 1
40  INTERVAL ON
50  GOTO 50
1000  PRINT TIME
1010  RETURN
```



The internal construction is utilitarian in the extreme, later models have an external power supply. Those empty ROM sockets are for alternate character sets and the little board between them and the transformer is the Z80 option.

To a casual reader, this program looks as if it won't do anything useful and line 50 looks positively silly! However, what happens is that line 10 prints the time that the program starts running on the screen — TIME is a system variable that holds the current time — line 20 sets up the line number of a subroutine which will be used to handle the 'interrupt' (in this case subroutine 1000) line 30 sets the time interval between interrupts (in this case one second) and line 40 allows interrupts to happen. The program then loops at line 50 apparently without ever doing anything useful. However, after one second (the interrupt interval) an interrupt occurs and control passes from line 50 to subroutine 1000 which prints the time and then RETURNs. Control returns to the line which BASIC would have executed if the interrupt hadn't happened and so the loop at line 50 is resumed. After another second, another interrupt occurs and the whole process is repeated. The result is that the time is printed on the screen exactly once every second.

In a real program, of course the loop at line 50 would be replaced by lines of BASIC which do some useful work — but no matter what was going on, as long as INTERVAL ON was in effect, the time would be printed every second. You should be able to see where the name 'interrupt' comes from — the program is indeed interrupted every second!

The F-BASIC contains a number of statements which can be used to automatically transfer control when a specified event occurs. For example, you can use ON TIME GOSUB which will transfer control at a particular time of day (as opposed to after a time interval), ON KEY GOSUB which will transfer control when a specified programmable key is pressed, and ON COM GOSUB will transfer control when a communications channel (serial port) needs to send or receive data. Why other versions of BASIC haven't thought of implementing interrupts in this way is beyond me because it is a very short step from ON ERROR GOSUB/GOTO to F-BASIC's range of ON interrupt GOSUB statements! Whatever the reason, F-BASIC has a significant advantage if you want to do clever things!

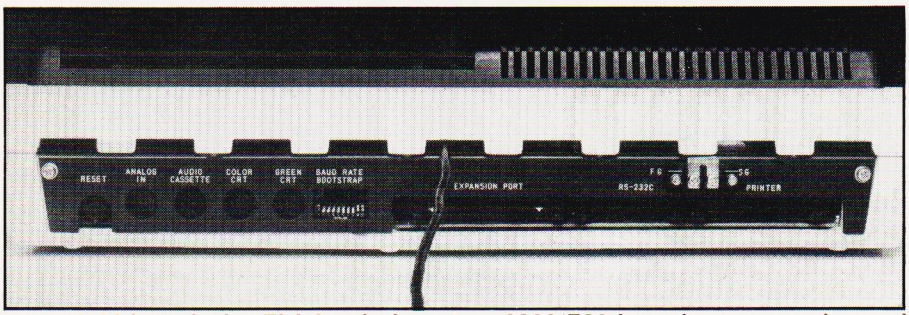
One interesting F-BASIC statement which doesn't fit into any particular category is UNLIST. UNLIST will make any section of a program unlistable for protection purposes and so far, at least, I haven't been able to find a way of undoing what UNLIST has done! One slight disappointment is the lack of any real audio commands. F-BASIC seems to be restricted to BEEP ON and BEEP OFF!

Apart from F-BASIC, the only other piece of software that is of any concern to the user is a machine code monitor which can be used to examine and modify memory directly. A very useful feature not found in many machine code monitors is the ability to turn the FM-8 into a computer terminal with a single command!

DOCUMENTATION

You might expect me to slip in a few jokes about Japanese manuals at this point in the review — well, you'd be▶

Above: The Japanese manuals are pretty but unreadable, the English versions suffice.
Below: A wide range of interface connectors appear on the rear panel, the screw terminals are earth connections.



wrong! Although the FM-8 only has some poorly bound manuals (that must surely be temporary) the standard of the English is very good. However, if you're looking for an introduction to BASIC then I'm afraid you'll have to look elsewhere. The manuals are written at an intermediate level that will suit the expert but still leave a vague gap about one or two details. I know that the FM-8 is distributed in Japan with an excellent beginner's manual — written in Japanese, of course — and I should think that any introduction of the machine into this country on a large scale would bring a translation of this manual. For now, all I can do is to describe the documentation as adequate and hope for more later.

EXPANSION

To a certain extent, the real reason for anyone going for the FM-8 is contained in this section. It's not so much what the unexpanded FM-8 can offer that is likely to attract a buyer in the UK, it is the range of extras! (This is not to say that the unexpanded FM-8 is not a very good machine, just that there are UK-supported machines that offer very nearly the same specifications). Once you add a disc drive to the machine, you have access to a range of operating systems — for example, FLEX and UCSD Pascal. The discs are connected to an expansion bus via a ribbon cable and hold 320K per drive (double density, double sided). If you don't want to use the 6809's operating systems, then you can add a Z80 card very easily and then the world of CP/M based software is open to you. So, if you need a 6809/Z80 based system with good graphics then the FM-8 is very attractive.

The other expansion option which puts the FM-8 into a class of its own is bubble memory. If you have a good memory, you will recall that bubble memory was the one hope that we had for a solid state replacement for floppy discs. I say 'had' because it seems to be the general concensus that bubble memory was too expensive and too difficult to mass produce for a commercial market. Well, this may be the consensus over here but the Japanese don't seem to be taking any notice!

A surprising number of Japanese micros have bubble memory options and the FM-8 is one of their number. You can use two 32K bubble memory cassettes in the FM-8. However, a cassette costs around £100 so you really need an application which cannot work without bubble memory before rushing in to use it. (It's about 100 times more expensive than using floppy discs!) Its advantages are that it is faster than disc and can be used in dusty and hostile atmospheres because it has no moving parts. Only time will tell if bubble memory will catch on but one thing is certain, unless somebody takes the first step and uses it in a personal computer, there won't be the incentive to continue with its development and its price will remain high.

There is also a range of other extras — IEEE 488 interface, plotter interface, sound modules, etc. However, I cannot comment on their availability or design.

CONCLUSION

The FM-8 is an important machine in that it offers an alternative to the simple single processor, single address space type of computer which is becoming the standard (and slightly boring!) design used for just about every new machine. If you want a quality 6809, expandable system with excellent graphics then it is worth looking at the FM-8. The FM-8 reviewed here was kindly loaned for the purpose by Stirling Microsystems.

FACTSHEET	Fujitsu FM-8	
CPU	6809 (two)	
ROM	44K	
RAM	128K	
Language	F-BASIC	
Keyboard	95 key QWERTY plus Katakana characters Numeric keypad Cursor control keys 10 programmable function keys	
Display	Text: 25 lines of 40 characters 25 lines of 80 characters Graphics resolution 640 by 200 Eight colours	
Cassette I/O	1,600 baud	
Options	RS232 and Centronics ports Four channel A to D Twin 5¼" discs Bubble cassette 32K bubble store Z80 processor card FM-8	£1,190 £399 £179 £57.50 £999
Cost		
Supplier	Stirling Microsytems 241 Baker Street London NW1 6XE 01-486 7671	

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ZX Spectrum
BLUE EDIT
RED CAPS LOCK
MAGENTA TRUE VIDEO
GREEN INV. VIDEO
CYAN
YELLOW
WHITE
GRAPHICS
BLACK DELETE
1 ! DEF FN
2 @ FN
3 # LINE
4 $ OPEN #
5 % CLOSE #
6 & MOVE
7 ' ERASE
8 (POINT
9) CAT
0 _ FORMAT
SIN COS TAN INT RND STR$ CHR$ CODE PEEK TAB
Q <= PLOT ASN
W <> DRAW ACS
E >= REM ATN
R < RUN VERIFY
T > RAND MERGE
Y AND RETURN [
U OR IF]
I AT INPUT IN
O ; POKE OUT
P " PRINT ©
READ RESTORE DATA SGN ABS SQR VAL LEN USR
A STOP NEW ~
S NOT SAVE |
D STEP DIM \
F TO FOR {
G THEN GOTO }
H ↑ GOSUB CIRCLE
J − LOAD VAL $
K + LIST SCREEN $
L = LET ATTR
ENTER
LN EXP LPRINT LLIST BIN IN KEY$ PI
CAPS SHIFT
Z : COPY BEEP
X £ CLEAR INK
C ? CONT PAPER
V / CLS FLASH
B * BORDER BRIGHT
N , NEXT OVER
M . PAUSE INVERSE
SYMBOL SHIFT
BREAK SPACE

Sinclair ZX Spectr

16K or 48K RAM... full-size moving-key keyboard... colour and sound... high-resolution graphics...

From only £125!

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

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Professional power– personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.

Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set – with upper- and lower-case characters.
- Teletext-compatible – user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

um

The ZX Printer – available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set – including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

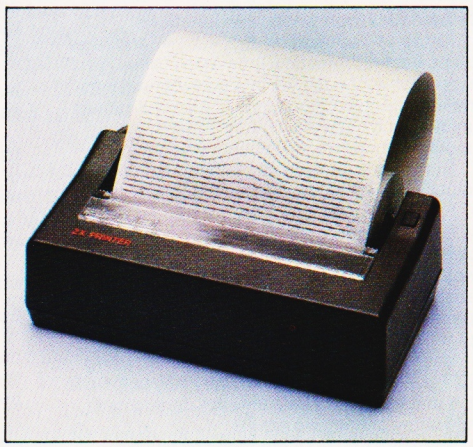
The ZX Microdrive – coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing by providing mass on-line storage.

Each Microdrive can hold up to 100K bytes using a single interchangeable storage medium.

The transfer rate is 16K bytes per second, with an average access time of 3.5 seconds. And you'll be able to connect up to 8 Microdrives to your Spectrum via the ZX Expansion Module.

A remarkable breakthrough at a remarkable price. The Microdrives will be available in the early part of 1983 for around £50.



How to order your ZX Spectrum

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp needed coupon below. You can pay by cheque, postal order, Barclaycard, Access or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum – 16K RAM version	100	125.00	
	Sinclair ZX Spectrum – 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
			Total £	

Please tick if you require a VAT receipt ☐

*I enclose a cheque/postal order payable to Sinclair Research Ltd for £

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable

Signature

PLEASE PRINT

Name: Mr/Mrs/Miss

Address

COT 902

FREEPOST – no stamp needed. Prices apply to UK only. Export prices on application.

ZX Spectrum software on cassettes – available now

The Spectrum software library is growing every day. Subjects include games, education, and business/household management. Flight Simulation...Chess...Planetoids...History...Inventions...VU-CALC...VU-3D...Club Record Controller...there is something for everyone. And they all make full use of the Spectrum's colour, sound, and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

ZX Expansion Module

This module incorporates the three functions of Microdrive controller, local area network, and RS232 interface. Connect it to your Spectrum and you can control up to eight Microdrives, communicate with other computers, and drive a wide range of printers.

The potential is enormous, and the module will be available in the early part of 1983 for around £30.

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Sinclair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS.
Tel: Camberley (0276) 685311.

Sinclair ZX Spectrum–technical data.

Dimensions

Width	233 mm
Depth	144 mm
Height	30 mm

CPU/ memory

Z80A microprocessor running at 3.5 MHz.
16K-byte ROM containing BASIC interpreter and operating system.

16K-byte RAM (plus optional 32K-byte RAM on internal expansion board) or 48K-byte RAM.

Keyboard

40-moving-key keyboard with full upper and lower case with capitals lock feature. All BASIC words obtained by single keys, plus 16 graphics characters, 22 colour control codes, and 21 user-definable graphics characters. All keys have auto repeat.

Display

Memory-mapped display of 256 pixels x 192 pixels; plus one attributes byte per character square, defining one of eight foreground colours, one of eight background colours, normal or extra brightness and flashing or steady. Screen border colour also settable to one of eight colours. Will drive a PAL UHF colour TV set, or black and white set (which will give a scale of grey), on channel 36.

Sound

Internal loudspeaker can be operated over more than 10 octaves (actually 130 semitones) via basic BEEP command. Jack sockets at the rear of computer allow connections to external amplifier/ speaker.

Graphics

Point, line, circle and arc drawing commands in high-resolution graphics.
16 pre-defined graphics characters plus 21 user-definable graphics characters. Also functions to yield character at a given position, attribute at a given position (colours, brightness and flash) and whether a given pixel is set. Text may be written on the screen on 24 lines of 32 characters. Text and graphics may be freely mixed.

Colours

Foreground and background colours, brightness and flashing are set by BASIC INK, PAPER, BRIGHT and FLASH commands. OVER may also be set, which performs an exclusive–or operation to overwrite any printing or plotting that is already on the screen. INVERSE will give inverse video printing. These six commands may be set globally to cover all further PRINT, PLOT, DRAW or CIRCLE commands, or locally within these commands to cover only the results of that command. They may also be set locally to cover text printed by an INPUT statement. Colour-control codes, which may be accessed from the keyboard, may be inserted into text or program listing, and when displayed will override the globally set colours until another control code is encountered. Brightness and flashing codes may be inserted into program or text, similarly. Colour-control codes in a program listing have no effect on its execution. Border colour is set by a BORDER command. The eight colours available are black, blue, red, magenta, green, cyan, yellow and white. All eight colours may be present on the screen at once, with some areas flashing and others steady, and any area may be highlighted extra bright.

Screen

The screen is divided into two sections. The top section – normally the first 22 lines – displays the program listing or the results of program or command execution. The bottom section – normally the last 2 lines – shows the command or program line currently being entered, or the program line currently being edited. It also shows the report messages. Full editing facilities of cursor left, cursor right, insert and delete (with auto-repeat facility) are available over this line. The bottom section will expand to accept a current line of up to 22 lines.

Mathematical operations and functions

Arithmetic operations of +, –, ×, ÷, and raise to a power. Mathematical functions of sine, cosine, tangent and their inverses; natural logs and exponentials; sign function, absolute value function, and integer function; square root function, random number generator, and pi.

Numbers are stored as five bytes of floating point binary – giving a range of $+3\times10^{-39}$ to $+7\times10^{38}$ accurate to $9\frac{1}{2}$ decimal digits.

Binary numbers may be entered directly with the BIN function. =, >, <, >=, <= and <> may be used to compare string or arithmetic values or variables to yield 0 (false) or 1 (true). Logical operators AND, OR and NOT yield boolean results but will accept 0 (false) and any number (true).

User-definable functions are defined using DEF FN, and called using FN. They may take up to 26 numeric and 26 string arguments, and may yield string or numeric results.

There is a full DATA mechanism, using the commands READ, DATA and RESTORE.

A real-time clock is obtainable.

String operations and functions

Strings can be concatenated with +. String variables or values may be compared with =, >, <, >=, <=, <> to give boolean results. String functions are VAL, VAL$, STR$ and LEN. CHR$ and CODE convert numbers to characters and vice versa, using the ASCII code.

A very powerful string slicing mechanism exists, using the form a$ (x TO y).

Variable names

Numeric – any string starting with a letter (upper and lower case are not distinguished between, and spaces are ignored).
String – A$ to Z$.
FOR-NEXT loops – A-Z.
Numeric arrays – A-Z.
String arrays – A$ to Z$.

Simple variables and arrays with the same name are allowed and distinguished between.

Arrays

Arrays may be multi-dimensional, with subscripts starting at 1. String arrays, technically character arrays, may have their last subscript omitted, yielding a string.

Expression evaluator

A full expression evaluator is called during program execution whenever an expression, constant or variable is encountered. This allows the use of expressions as arguments to GOTO, GOSUB, etc.

It also operates on commands allowing the ZX Spectrum to operate as a calculator.

Cassette interface

The ZX Spectrum incorporates an advanced cassette interface. A tone leader is recorded before the information to overcome the automatic recording level fluctuations of some tape recorders, and a Schmitt trigger is used to remove noise on playback.

All saved information is started with a header containing information as to its type, title, length and address information. Program, screens, blocks of memory, string and character arrays may all be saved separately.

Programs, blocks of memory and arrays may be verified after saving to confirm successful saving.

Programs and arrays may be merged from tape to combine them with the existing contents of memory. Where two line numbers or variables names coincide, the old one is overwritten.

Programs may be saved with a line number, where execution will start immediately on loading.

The cassette interface runs at 1500 baud, through two 3.5 mm jack plugs.

Expansion port

This has the full data, address and control busses from the Z80A, and is used to interface to the ZX Printer, the RS232 and NET interfaces and the ZX Microdrives.

IN and OUT commands give the I/O port equivalents of PEEK and POKE.

ZX81 compatibility

ZX81 BASIC is essentially a subset of ZX Spectrum BASIC. The differences are as follows.

FAST and SLOW: the ZX Spectrum operates at the speed of the ZX81 in FAST mode with the steady display of SLOW mode, and does not include these commands.

SCROLL: the ZX Spectrum scrolls automatically, asking the operator "scroll?" every time a screen is filled.

UNPLOT: the ZX Spectrum can unplot a pixel using PLOT OVER, and thus achieves unplot.

Character set: the ZX Spectrum uses the ASCII character set, as opposed to the ZX81 non-standard set.

ZX81 programs may be typed into the ZX Spectrum with very little change, but may of course now be considerably improved. The ZX Spectrum is fully compatible with the ZX Printer, which can now print out a full upper and lower case character set, and the high resolution graphics; using LLIST, LPRINT and COPY.
ZX81 software cassettes and the ZX 16K RAM pack will not operate with the ZX Spectrum.

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ZX Spectrum

Sinclair Research Ltd, Stanhope Road, Camberley, Surrey, GU15 3PS. Tel: Camberley (0276) 685311.

ELEGANT PROGRAMMING

Our series on advanced programming techniques takes a sideways step this month into the world of graphics. It's really moving stuff!

There is no way that a programmer can avoid using graphics on today's crop of microcomputers. Indeed, many a micro is dedicated to the production of graphics displays of all kinds. The trouble is that most programmers have to learn the necessary techniques by trial and error. If you turn to text books for programming, you'll find that most of them concentrate on the more 'serious' aspects of graphics such as three dimensional representations etc. What you are unlikely to find information about is the comparatively crude static graphics used to 'brighten' an otherwise dull screen presentation or about the special techniques needed to produce synchronised dynamic graphics of the sort used by video games. This lack of information is probably due to the difficulty in producing any sort of theory of graphics programming.

In practice a good graphics programmer achieves his end product by a mixture of ad hoc rules and methods and a sense of good design.

It is possible to learn something about the *ad hoc* rules and methods but if you don't have a sense of design the best thing to do is to ask someone who has what they think of your product and take notice of their comments.

GRAPHICS HARDWARE

Before going on to consider the software side of graphics it is necessary to consider the various ways that computers handle graphics. Rather than give a complete list of every possible technique for producing graphics, which although interesting would take a lot of space, it seems more useful to limit the description to microcomputers. The world of microcomputer graphics is divided according to whether the electronics for the graphics facility is 'memory mapped' or 'port controlled'.

Memory mapped graphics is the most common way of providing graphics on micros because it is cheap and easy to use. The key feature of memory mapped graphics is that a portion of the computer's main memory is assigned to the production of a screen display. The contents of this area of memory is 'converted' by the computer's video circuitry to an image on the screen in such a way that a single memory location controls what is displayed at a particular area of the screen. The exact way that this happens varies quite widely but it is possible to distingush two general approaches — block character graphics and pixel graphics. If each memory location controls an area of the screen so that what it displays depends on a code stored in memory location then this is block character graphics. If however the pattern that appears on the screen depends on the pattern of 0's and 1's stored in the memory location then this is pixel graphics. (Pixel being short for picture element.)

Port controlled graphics are far less common in the microcomputer world. Instead of allocating an area of memory in the main machine to graphics an alternative approach is to build a separate 'graphics device' with its own memory etc and allow the computer to communicate with it over an interface port of some description. A typical example of this approach is a graphics VDU which can be attached to any computer via a serial port. Port controlled devices have two main advantages — they do not use any of the computer's main memory and, in principle at least, they can be connected to any computer. Their principle disadvantages are cost and speed. Such a device duplicates many facilities already in the computer and communicating over a port is usually slow compared to memory mapped access. Because of the high cost of port controlled graphics you would think that you would never come across such a thing with a micro. In practice however what tends to happen is that a machine will have a video section built into the same box that has its own memory etc and communicates with the 'main computer' through a fast port or a small area of common memory.

All this classification of graphics systems is a little difficult to absorb at first so perhaps Table 1 might help. Real micros often use schemes that are not wholly described by any of the above categories. However it is normally possible to say that a micro's graphics is more like one than the other.

A SOFT VIEW

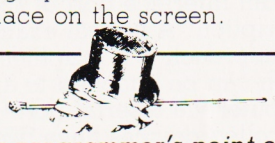
The above discussion is only of interest to programmers in so far as the hardware affects the graphics software provided. Because port controlled devices vary so much it is really only possible to describe the software techniques normally used with memory mapped graphics.

The easiest sort of graphics for a beginner to use are block graphics. The reason for this is that block graphics are handled in exactly the same way that alphanumeric characters are. If you know how to print the letter 'A' at a particular position on the

Memory mapped	—	each memory location controls what is displayed on an area of the screen
Port controlled	—	What is displayed on the screen is controlled by sending codes and other information over an interface port
Pixel graphics	—	a correspondence between the pattern of 0's and 1's stored in a memory location and what appears on the screen
Block graphics	—	No correspondence between the pattern of 0's and 1's and what appears on the screen. The content of each memory location is treated as a code that determines what will be displayed.

Table 1. First select your control mechanism and then the character type. Most common micros use memory mapped screens nowadays but more and more are turning to pixel graphics in the search for higher resolution displays.

screen then you can also print a special graphics character at the same place on the screen.



From a programmer's point of view block graphics look like an extended character set that can be PRINTED on the screen

Thus no new graphics commands are required to produce block graphics displays. All you need is the ability to select the correct graphics characters and position them on the screen to make up the 'shape' that you require. For example you may draw a box on the screen by finding the correct set of lines and corners among the character set and printing them in the right place. Drawing with graphics characters is rather like the old pastime of using a mechanical typewriter to make pictures!

Finding the correct characters to make up outlines of objects etc can be quite difficult until you are familiar with the character set provided. Indeed if a particular character that you require is missing then you will find that you cannot draw everything you want to. Offset against this lack of complete freedom to draw anywhere on the screen is the existance of solid graphics characters such as the four card symbols (heart, diamond, spade and club). The range of such graphics characters varies according to the particular machine you are using but it can be very wide and include such oddities as tank and spaceship shapes, guns, people, animals etc. The ability to print an entire space ship in one go at a specified screen location is very useful if you are writing games programs but not so appealing if you are trying to plot a graph!

Pixel graphics on the other hand are ideal for drawing graphs and other complicated outlines. As each point on the screen is associated with a particular bit in memory it is possible to alter any area of the screen independently of the rest. This gives rise to commands such as:

```
PLOT x,y
```

which (in many versions of BASIC) will make a point appear on the screen at a position specified by x and y. Using this command it is possible to draw any shape you require — straight line, circles etc. However, to make life even easier many versions of BASIC include some extra commands to draw a line or circle directly. The main problem with pixel graphics is that if you want to plot a solid shape such as a space ship or one of the card suit symbols it can take a large number of commands. At worst you will need one PLOT type command for every point in the shape and this is often as many as 64 or even 100!

Pixel graphics are good for drawing large outlines. Block graphics are good for small solid shapes.

As with all things in computers the subject of block and pixel graphics is not clear cut. For example the ZX81 uses block graphics but has a PLOT command. The BBC Micro and the ZX Spectrum both use pixel graphics but, because they have software provided for user-defined graphics they can be treated like block graphics machines. Using software it is possible to have the best of both worlds — except for one case... Some machines use the block character method to generate screens full of text but then use memory mapped pixel method for graphics. On such machines it is difficult to mix text and graphics without a great deal of extra software effort. (For example, in text mode the Apple uses block characters but in hi-res graphics mode uses pixel graphics).

THE SCREEN MAP

Although the memory mapped machines provide commands such as PLOT to enable the manipulation of individual bits in memory and hence individual points on the screen it is often the case that a more direct approach works better. It is possible to alter the contents of ***any*** memory location using the BASIC command:

```
POKE address,data
```

which stores the value 'data' in the memory location at 'address'. This means that it is possible to alter the contents of memory in the screen area directly and bypass the supplied graphics commands.

If you know that the screen occupies memory from 'START' to 'FINISH' then you might like to try the following two programs:

```
10  FOR I=0 TO 255
20  POKE START,I
30  NEXT I
```

and:

```
10  FOR I=START TO FINISH
20  POKE I,46
30  NEXT I
```

The first of the programs stores all the possible bit patterns into the first memory location of the screen area. This will give you two pieces of information — what place on the screen the first memory location corresponds to and what each bit pattern produces. Very often the first memory location corresponds to one of the four corners of the screen but this is not always the case. If your machine uses block graphics then each bit pattern will produce a whole new character on the screen. If your machine uses pixels, then you will only see eight points at most change. The second program POKEs a marker character into each memory location. If you watch the order that they appear you can determine how the memory locations correspond to the screen positions. For many machines it is possible to give a very simple formula for the way the memory location corresponds to screen positions and this is known as a screen map. It is important to notice that this is not always possible because the correspondence can be very complicated.

If you know the screen map for your machine then it is possible to manipulate it directly. The main reason for wanting to do this is speed and so POKEs (and PEEKs) make up the greater part of many moving or dynamic graphics programs.

DYNAMIC GRAPHICS

Moving graphics are the main constituent of almost all computer games. This is not to say that they haven't any 'real' applications it just emphasises how much fun dynamic graphics can be. Although it is often obvious how to draw simple shapes on the screen it is often something of a puzzle to know how to make them move and even more of a puzzle to know how to produce all the dazzling effects seen in computer games — collisions, explosions, bouncing balls etc. While it is important to realise that many of the most stunning effects produced by games machines are the product of special hardware it is easy to produce very good moving graphics even from BASIC.

The principle behind moving graphics is not difficult to understand. A cine film (or a normal television picture) gives the

impression of movement by showing a sequence of motionless pictures. The sequence of pictures is in fact a jerky and jumpy approximation to the truly smooth movement that it represents but the eye is fooled into smoothing the jumps out. This perception of a sequence of still images as a smoothly moving object is possibly the only visual illusion that is used by technology. Making things move on a computer screen uses the same principle. The only problem is how to produce the sequence of images required. If you want to make something move across the screen then all you have to do is to plot it then remove it (unplot it) and then plot it again but at a slightly different position. By repeating this plot/unplot/move action the object can be made to 'slide' about the screen.

For example, to make something move horizontally try:

```
10  X=1
20  Y=middle
30  PRINT TAB(X,Y);"A"
40  PRINT TAB(X,Y);"[SPC]"
50  X=X+1
60  GOTO 30
```

For simplicity we are assuming that PRINT TAB(X,Y) will position the cursor at the Xth column and the Yth row. Of course this has to be replaced by whatever graphics command your version of BASIC has. Also 'middle' should be replaced by a value that starts the 'A' off in a reasonable position to be seen.

If you do run the above program on your machine you will see a letter 'A' shoot across the screen but you might not be very pleased at how smoothly it moves. On most machines it will in fact appear to twinkle as it moves. The reason for this is two-fold. Firstly, the letter 'A' moves in 'jumps' that are rather too big to completely fool the eye into seeing smooth motion. And secondly there is an imbalance between the time that the 'A' is displayed and the time that it is not. Ideally the time that the 'A' is on the screen should be long compared to the time that it is off. Unfortunately the above program doesn't really leave the 'A' on the screen for long enough before removing it by printing a blank at the same place. To see the effect of increasing the time that the 'A' is on the screen try adding:

```
35  FOR I=1 TO N
36  NEXT I
```

with different values of N to produce different delays between printing the 'A' and removing it.

This plotting and then unplotting is the way all dynamic graphics are produced. The only trouble is that between the plotting and unplotting you have to do all the calculations concerning the movement of the object (and any other objects being moved by the program). In BASIC this can take so long that dynamic graphics look more like slow motion. There is no solution to this problem apart from moving to a faster language and this often means machine code.

VELOCITY

Making something move across the screen in a straight line as in the last example is all very well but it's hardly inspiring. The next step is to allow the moving object to move in more complicated ways. Although this is just a matter of calculating the positions that the object should take up it is more useful to think of this in another way.

If the time interval between plotting and unplotting an object is constant (and it nearly always is) then the distance that the object moves can, in some senses, be thought of as being related to a 'velocity'. The higher the velocity the greater the distance moved each time. Putting these ideas into practice involves defining two 'velocities' a horizontal velocity and a vertical velocity. If these are stored in two variables H and V then the process of calculating the new position of the object is simply:

```
X=X+H
Y=Y+V
```

In other words in each time period the horizontal position changes by an amount equal to the horizontal velocity and the vertical distance changes by an amount equal to the vertical velocity. As an example consider the following program using the same conventions as the last example:

```
10  V=1
20  H=1
30  X=1
40  Y=1
50  PRINT TAB(X,Y);"A"
60  PRINT TAB(X,Y);"[SPC]"
70  X=X+H
80  Y=Y+V
90  GOTO 50
```

This makes the letter "A" move diagonally across the screen.

The full advantage of treating the movement of objects in terms of velocities is easy to see once you consider the problem of 'bouncing' a 'ball' around the screen. If the 'ball' meets a vertical 'wall' all you have to do is to reverse the horizontal velocity. If the 'ball' meets a horizontal 'wall' then the vertical velocity has to be reversed. In a cross between English and BASIC this becomes: If you can translate the conditions in each of the IF statements into proper BASIC for your machine then these two lines can be added to the previous example to give a program that 'bounces' the letter 'A' around the screen! The same method can be used to 'bounce' objects off bats etc.

ACCELERATION

The idea of using velocities to control the motion of objects is very useful but results in things travelling only in straight lines. To introduce curvature to the paths that objects take it is necessary to add the idea of acceleration. If at each step we not only modify the position of the object but also the velocities then it will travel along curved paths. For example, if we introduce a vertical acceleration we can produce a falling object:

```
10  H=1
20  V=0
30  A=0.2
40  X=1
50  Y=1
60  PRINT TAB(X,Y);"A"
70  PRINT TAB(X,Y);"[SPC]"
80  X=X+H
90  Y=Y+V
100 V=V+A
110 GOTO 60
```

As the object (the letter 'A') moves across the screen the vertical velocity increases because of line 100. This steady increase in velocity causes the 'A' to fall in a parabola. By using horizontal and vertical velocities and accelerations it is possible to produce a wide variety of motions.

CONCLUSION

Dynamic graphics is one of the most enjoyable areas of programming and with very little extra knowledge a wide range of effects can be achieved. Once the basic method of making things move is understood nearly everything else can be handled in terms of velocity and acceleration. To make a number of objects move at the same time all you have to do is keep track of the position, velocity and acceleration of each one of them. In theory this sounds quite straightforward but in practice, of course, it may be quite a confusing task — especially if you ignore the hints contained in earlier parts of this series!

Next month we deal with two very common problems — searching and sorting.

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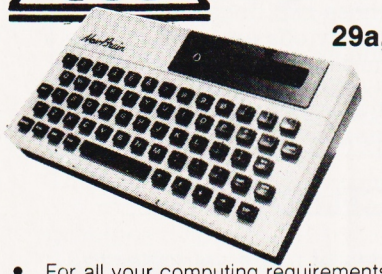

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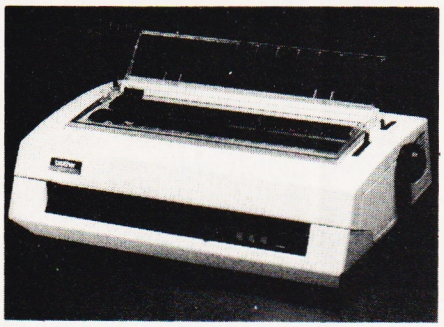

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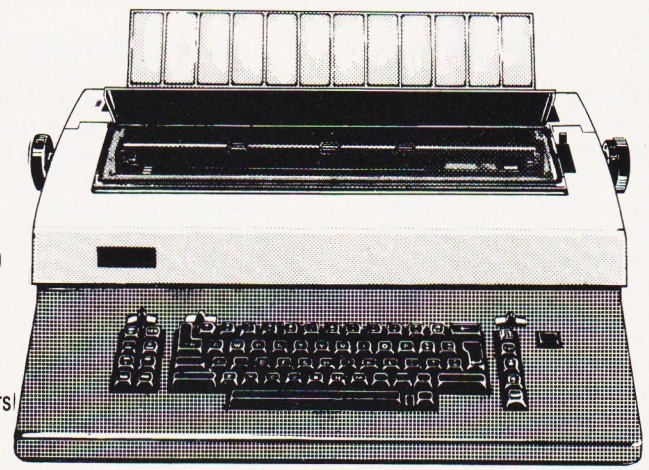

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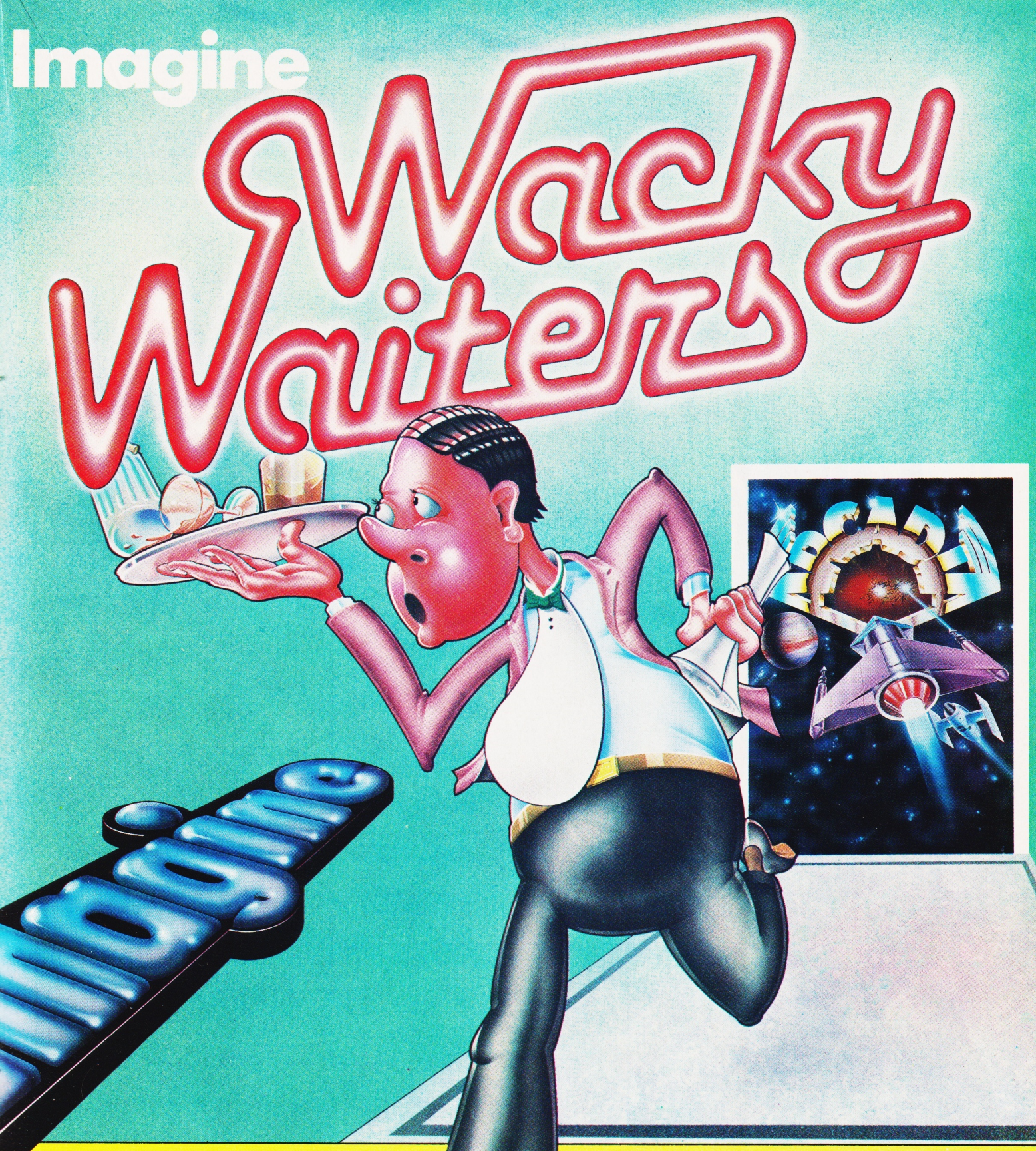

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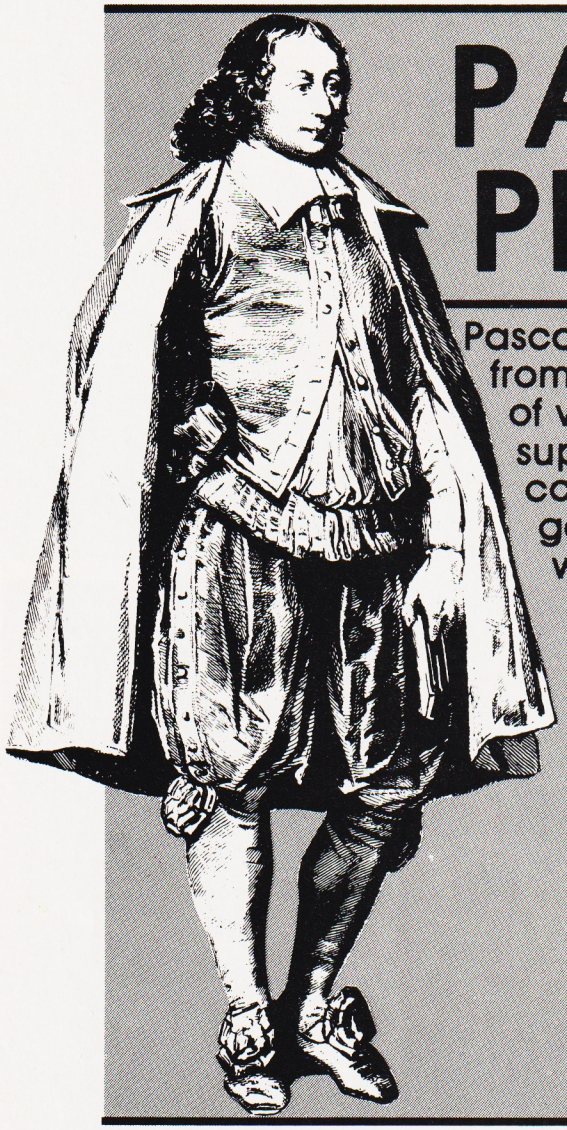

PASCAL PROFILE

Pascal varies considerably from BASIC in the types of variable that it supports. This month we consider how you can get the most out of what Pascal has to offer.

In last month's article we studied some of the simplest Pascal statements and wrote a few short programs. This month we will look at a major Pascal feature — data typing — and we'll continue to learn new instructions.

In most versions of BASIC you can use two or three different types of variable; floating point numbers, 'strings' of text, and perhaps integer variables (for whole numbers only, taking up less memory space than floating point). Pascal has equivalents for each of these, and for almost any other type of variable you can dream up!

VARIOUS VARIABLES

Last month we illustrated the use of REAL and INTEGER variables in a Pascal program. After the program heading you type the word VAR (indicating that what follows is a list of VARiable declarations) and then type the name and type of each variable you wish to use. Consider the start of the horribly boring program SUMMARY in Fig. 1:

```
PROGRAM SUMMARY(INPUT,OUTPUT);
(* THIS PROGRAM READS A LIST OF WHOLE NUMBERS AND THEN
   DISPLAYS THE LARGEST, SMALLEST AND AVERAGE OF THEM *)
VAR INDEX,TOTAL : INTEGER;
    DATA : ARRAY [1..10] OF INTEGER;
    AVERAGE : REAL;
    BIGGEST,SMALLEST : INTEGER;
BEGIN
   (* READ IN ALL THE DATA *)
   FOR INDEX:=1 TO 10 DO
   BEGIN
      WRITE('ENTER VALUE NO. ',INDEX,' ? ');
      READ(DATA[INDEX])
   END;
   (* NOW SET UP THE SUMMARY *)
   TOTAL:=DATA[1]; (* JUST THE FIRST ITEM SO FAR *)
   SMALLEST:=DATA[1]; BIGGEST:=DATA[1];
   (* CONSIDER THE REMAINING VALUES ONE BY ONE *)
   FOR INDEX:=2 TO 10 DO
   BEGIN
      TOTAL:=TOTAL+DATA[INDEX];
      IF DATA[INDEX]<SMALLEST THEN
         SMALLEST:=DATA[INDEX];
      IF DATA[INDEX]>BIGGEST THEN
         BIGGEST:=DATA[INDEX]
   END;
   (* PRINT OUT THE RESULTS *)
   WRITELN('SMALLEST VALUE : ',SMALLEST,'.');
   WRITELN('LARGEST  VALUE : ',BIGGEST ,'.');
   AVERAGE:=TOTAL/10;
   WRITELN('AVERAGE  VALUE : ',AVERAGE,'.')
END.
```

Fig. 1. The SUMMARY program illustrates the use of further variable types.

The first line of the program shows its name and indicates that it uses the keyboard and display of the micro (INPUT and OUTPUT respectively). Then comes a two line comment (optional, and ignored by the compiler) which explains the purpose of the program, followed by the 'declaration' (list) of the variables used.

The word 'VAR' indicates the start of the list. TOTAL and INDEX are declared as INTEGER variables (which can only store whole number values). We could have put the names separately, as in:

```
VAR INDEX:INTEGER; TOTAL:INTEGER;
```

. . .etc.

Pascal doesn't mind which format we use, so long as a comma separates names in a list and we use a colon and semi-colon to mark the start and end of the variable type(INTEGER in this case).

DATA is an array. Pascal arrays are similar to BASIC ones, except their subscripts (element numbers) are enclosed in square brackets. That sometimes makes it easier to understand arithmetic expressions which use array variables. The line declaring DATA is really fairly easy to understand — the '1..10' means 'the range 1 to 10', so the statement:

```
DATA : ARRAY [1..10] OF INTEGER;
```

tells Pascal to set up an array of 10 INTEGERs named DATA [1], DATA [2], DATA [3] and so on up to DATA [10]. The effect is similar to that of DIM DA%(10) in BASIC, except in Pascal you can start your subscripts with any whole number value — 0, 1, 10, or even −100 if you want to! Most versions of BASIC automatically start array subscripts with the

value 0, so that DIM DA%(10) sets up an array of 11 elements numbered from 0 through to 10.

Average is declared as a REAL variable since it may have to hold a decimal number (obviously, since the average of a list is the total of all the values divided by the length of the list). BIGGEST and SMALLEST are declared as a couple more INTEGER variables. Pascal doesn't mind what order you declare variables in — you can mix up declarations for integers, arrays, reals and so forth as much as you like so long as all the declarations are together after the VAR.

Most of the rest of SUMMARY is based on last month's lesson. BEGIN and END 'bracket' sections of the program together, and semi-colons are used to separate statements (hence there is no semi-colon after READ (DATA[INDEX]) because it is the last statement before an END). As usual for Pascal, values are put into variables with the 'becomes' symbol ':=' rather than '=' used in BASIC.

The program works by reading in all the data items and then 'assuming' that the first item of data is both the largest and smallest (!). Then it checks all the other items, adding them up as it goes along, testing them and changing its notion of largest and smallest if it finds new extreme values.

As we decided earlier, the average of the number of items in the list can't be an integer because it may not turn out to be a whole number. The line AVERAGE:=TOTAL/10; is slightly unusual Pascal in that it takes two integer values and produces a 'real' (decimal) result. If AVERAGE had been set up as an integer variable we would have to say:

```
AVERAGE:=TOTAL DIV 10;
```

DIV works in a similar manner to '/', but produces an integer result (rounded down to the nearest whole number). For this reason DIV is usually quicker but less accurate than '/'. Pascal compilers generate an error message if you try to store a real number in an integer variable, so it is important to make sure that you don't use '/' in a calculation and then try to store the result in an integer variable — you can always use a function to convert the real into an integer and then store the result. It doesn't matter if you store an integer value in a real variable, since there is precision to spare!

SUMS IN PASCAL

At this point it is worth considering the way Pascal treats arithmetic. This turns out to be one of the most straightforward aspects of the language from the point of view of a BASIC programmer. So long as you remember to type 'becomes' (':=') instead of 'equals' you will find that most BASIC calculations will not need to be re-expressed in a Pascal program. You can type:

```
GRAPH[I]:=SIN(X)*PI/(COS(Y)-1)+2
```

(remember the square brackets for arrays!). The line should be evaluated just as it would be by BASIC, except rather faster since Pascal is a compiled language — the Pascal system does not have to search great lists to find out where it last stored X, or fiddle around converting the digit '2' into binary before it can carry out the calculation.

There are a few hidden pitfalls; 'SIN', '/' and 'COS' are all functions which can generate decimal results, so the array GRAPH must have been declared as a REAL. Similarly array subscripts (for example, 28 in the value GRAPH [28]) must be integer values — otherwise you could end up with a variable called GRAPH [28.571428], which would not be a good idea. Like BASIC, Pascal follows the rules of algebra, first working out values in brackets, then divisions and multiplications, and then addition or subtraction. Unlike BASIC, Pascal does not leave logical expressions like AND, OR and NOT until last, so you sometimes need a few extra brackets in your IF statements. That is illustrated later in this article.

Beware of the Pascal function SQR. In BASIC SQR(4) is 2 — in Pascal SQR(4) is 16, SQRT(4) is 2! Different versions of Pascal have various functions available, but most have ABS, LN (natural log), EXP (anti-log), SIN, COS, TAN, ARCTAN etc. Besides DIV for integer division, Pascal provides a useful MOD function which gives the remainder when one integer is divided by another: 37 MOD 30 is 7, 2 MOD 10 is 2, 6 MOD 2 is 0, etc.

CONSTANT VIGIL

One of the annoying things about SUMMARY becomes obvious if you try to change the size of the list it will process. You have to go through the program replacing every occurrence of the constant '10' with the new list size. If SUMMARY was a large program you could easily miss one reference and make the program incorrect. Worse still, you might change an occurrence of '10' which wasn't connected with the list size at all, and mess up a completely different aspect of the program.

Pascal has a facility which is designed to reduce the risk of this happening. At the start of a Pascal program you can collect together some or all of the 'magic numbers' that will be used in a program and give them meaningful names. Every time you need to know the number of data items in the program you can then write the name, say DATACOUNT, instead and the Pascal compiler will treat

```
PROGRAM SUMMARY2(INPUT,OUTPUT);
(* A MODIFIED VERSION OF SUMMARY WHICH USES A CONSTANT
   DECLARATION TO EXPRESS THE NUMBER OF DATA ITEMS *)
CONST DATACOUNT=10;
VAR INDEX,TOTAL : INTEGER;
    DATA : ARRAY [1..DATACOUNT] OF INTEGER;
    AVERAGE : REAL;
    BIGGEST,SMALLEST : INTEGER;
BEGIN
   (* READ IN ALL THE DATA *)
   FOR INDEX:=1 TO DATACOUNT DO
   BEGIN
      WRITE('ENTER VALUE NO. ',INDEX,' ? ');
      READ(DATA[INDEX])
   END;
   (* NOW SET UP THE SUMMARY *)
   TOTAL:=DATA[1]; (* JUST THE FIRST ITEM SO FAR *)
   SMALLEST:=DATA[1]; BIGGEST:=DATA[1];
   (* CONSIDER THE REMAINING VALUES ONE BY ONE *)
   FOR INDEX:=2 TO DATACOUNT DO
   BEGIN
      TOTAL:=TOTAL+DATA[INDEX];
      IF DATA[INDEX]<SMALLEST THEN
         SMALLEST:=DATA[INDEX];
      IF DATA[INDEX]>BIGGEST THEN
         BIGGEST:=DATA[INDEX]
   END;
   (* PRINT OUT THE RESULTS *)
   WRITELN('SMALLEST VALUE : ',SMALLEST,'.');
   WRITELN('LARGEST  VALUE : ',BIGGEST ,'.');
   AVERAGE:=TOTAL/DATACOUNT
   WRITELN('AVERAGE  VALUE : ',AVERAGE,'.')
END.
```

Fig. 2. A modified version of the SUMMARY program that uses constants.

the name as if it has the value associated with it by the declaration at the start of the program.

Figure 2 is a new version of SUMMARY which uses a constant declaration to express the number of data items. The new line looks similar to a variable declaration, but it uses an equals sign instead of a colon, and a constant value (a number or a character in quotes) instead of a variable type. You can set up as many constants as you like in program, but you must make sure that you don't try to give a constant the same name as a variable or you'll get an error message when you try to compile the program.

An alternative approach would be to set up a variable and then put the list size into it at the start of the program. In Pascal you don't need to do this if you know the value of the constant when you compile. The advantages of using a CONST declaration are fairly minor but they add up, especially in a large program.

Firstly, a CONST uses less memory space than a variable set up in the program — if you use a variable with the data count in it the computer must find somewhere to put it. Secondly, programs which use declared constants execute more quickly than ones using special variables, since a Pascal compiler can insert the value of a CONST straight into a calculation rather than generate an instruction to fetch the value of a variable. Finally, Pascal requires the programmer to collect all the CONST declarations near the start of a routine so that they're easy to find if they need changing.

Even if you haven't got a Pascal compiler it can be useful in your BASIC or Assembler programs to set up variables containing 'magic numbers' such as display height, line length and so forth. Then if you ever have to convert your program to run on a different computer you won't have to search through and change every occurrence of the numbers.

SETTING THE PACE

The array declaration in SUMMARY may have given you a few other ideas — the idea of using a pair of dots to indicate a range of values turns out to be very useful in Pascal. Have you ever had to test whether a letter read by a BASIC program is alphabetic? You probably ended up with a line like:

```
IF A$>="A" AND A$<="Z" THEN ...
```

In Pascal you may express that in a similar way:

```
IF (TEXT>='A') AND (TEXT<='Z') THEN ...
```

(the brackets are needed because Pascal normally does AND operations before comparisons — rather annoyingly) but in practice most Pascal programmers write such a test more elegantly:

```
IF TEXT IN ('A'..'Z') THEN ...
```

The 'double dot' sign is used to imply all the letters between 'A' and 'Z'. The IN operator works like an 'equals at least one of' sign — if the value on the left corresponds to any of the values on the right then the expression is true. Fairly sensibly, Pascal calls groups of values such as 'A'..'Z' 'sets'.

Consider what happens when you decide to check for lower case (small) letters as well! In BASIC you may end up with a line like:

```
IF (A$>="A" AND A$<="Z") OR
(A$>="a" AND A$<="z") THEN ...
```

In Pascal you can often collect up lists of like items and separate the items with commas, so that:

```
IF TEXT IN ('A'..'Z' , 'a'..'z')
THEN ...
```

is perfectly legal — and easy to read as well. If you then decide to include spaces in your list of valid characters, simply write:

```
IF TEXT IN ('A'..'Z', 'a'..'z' , ' ')
THEN ...
```

and so on. You can use 'sets' of numbers as well, so to check an exam percentage you might write:

```
IF PERCENTAGE IN (40..59) THEN WRITE('PASS')
   ELSE IF PERCENTAGE IN (60..89) THEN WRITE ('MERIT')
      ELSE IF PERCENTAGE IN (90..100) THEN WRITE ('CHEAT!')
```

CASTING YOUR OWN TYPE

Now we have a convenient way of collecting values together (using 'sets') it would be a waste not to make further use of it! One of the most fun things about Pascal programming is the way that you can specify your data in great detail. Rather than the strings, floating point numbers, and (sometimes) integers of BASIC, in Pascal you can make up variable types of your own. Returning to the example of the examination percentages, we could declare a new type of variable called MARKS, able to store a value from 0 to 100. To do this we just put in a new chunk of program before the VAR section. The TYPE section consists of a list of declarations of new kinds of variable. Figure 3 illustrates the start of a program using the new type MARKS.

At first sight this innovation may seem rather pointless — we could store the number of marks in an integer array, or even in an array of REALs if need be. There turn out to be quite a few advantages if we set up a new type of variable. Now that we have specified the range of reasonable MARKS values the Pascal system can check that we don't make mistakes and accidentally give someone more than 100 or a negative number of marks. This helps to make testing and maintenance of the program easier since if anything goes wrong we get an immediate warning — rather than let the error go unnoticed until the final reports are printed.

User-defined variable types also help to make programs more efficient in their use of memory. A good Pascal compile will recognise that a value between 0 and 100 can be stored in seven bits (since 2 ** 7 = 128) and will pack values into a small space. On most BASIC micro computers variable elements take up at least 16 bits and more commonly 32 — even if you are only using them to store a yes/no value.

Pascal has a special data type for yes/no values. BOOLEAN variables (named after a Victorian mathematician) occupy just one bit per value and can be assigned two values — TRUE or FALSE.

Special data type definitions help to make the purpose of variables obvious, especially in large programs, and hence they make programs easier to read and understand. If the array CLASSLIST is declared as containing PERCENTAGE values then it's obvious that CLASSLIST is an array of marks, rather than ages or the heights of homes above sea level.

```
PROGRAM DISMAL (INPUT,OUTPUT);
(* A PROGRAM TO STORE EXAM RESULTS *)
CONST CLASSSIZE=40;
TYPE PERCENTAGE= 0..100;
VAR CLASSLIST : ARRAY [1..40] OF PERCENTAGE;
... etc
```

Fig. 3. The start of this program illustrates the use of the variable MARKS.

SETTING RECORDS

It often happens that we need to store a number of different items of information under one heading. Pascal has a facility called the 'RECORD' which can be used to collect items of information together. Unlike a vinyl record, sections of a Pascal record are called fields (rather than tracks). Just as you can refer to a song on LP by the name of the album and then the name of the song, you refer to a Pascal field by the name of the record followed by the name of the field. If you want to store someone's age you can use:

```
TYPE AGETYPE=RECORD
   YEARS: 0..200;
   MONTHS: 0..11
END;
```

Now if you set up a variable called AGE of type AGETYPE you could load it with appropriate values and write, for example:

```
WRITELN('AGE:',AGE.YEARS,'YEARS',AGE.MONTHS,'MONTHS.');
```

The dot is used to separate the field name YEARS or MONTHS from the record variable name AGE. This month's final example illustrates the use of the Pascal record scheme.

RHYTHM OF THE ROM

When microcomputers first became available a deluge of Biorhythm programs were published — these claim to predict a person's mood on a given day by assuming that their emotional, mental and physical health varies in a cycle from the date of birth. One friend recently paid off the price of a VIC-20 in two days by setting up a 'Biorhythm stall' and selling individual graphs to customers.

Figure 4 shows a typical BASIC biorhythm program, designed to plot a graph on an 80-column printer. To illustrate the difference between simple BASIC and Pascal, Fig. 5 is an equivalent Pascal program.

The BASIC program uses a rather slow loop to set up the array which will contain the graphs — this loop resembles the Pascal code but it can seem very slow because of the way that BASIC organises string variables (using 'Garbage Collection' routines). Pascal character arrays are fixed-length so this problem does not occur (although more complex Pascal programs can use variable-sized structures). The variable size of BASIC strings is often an advantage, but it generates a few problems — line 290 illustrates the technique needed to change a single character in a string when using standard 8K BASIC.

Figure 5 illustrates the use of user-defined data-types to increase the readability and reliability of a Pascal program. The record used to store dates permits month values to range 0..14 since the program avoids problems with leap years by pretending that the most recent year started in January and ends at the beginning of March (a common trick). There is a potential snag if your Pascal compiler will only allow 16-bit integer variables — the value of ELAPSED may overflow. If you use 24- or 32-bit integers no problem will be found — alternatively store ELAPSED in a real and then ROUND it later.

Often you may feel the need to program a number of different

```
10 REM BASIC TO PLOT BIORHYTHM GRAPHS FOR ANY 30 DAYS
20 DIM PL$(29)
30 PRINT"ENTER YOUR DATE OF BIRTH (E.G. 10,3,61) ";
40 INPUT BD,BM,BY
50 PRINT"NOW ENTER THE CURRENT DATE IN THE SAME FORMAT ";
60 INPUT TD,TM,TY
70 REM WORK OUT THE NUMBER OF DAYS ELAPSED SINCE 1900
80 IF TM<3 THEN TY=TY-1 : TM=TM+12
90 EL=TD+INT((TM+1)*30.6)+INT(TY*365.25)
100 REM SUBTRACT THE NUMBER OF DAYS PRECEEDING USER'S BIRTH
110 IF BM<3 THEN BY=BY-1 : BM=BM+12
120 EL=EL-BD-INT((BM+1)*30.6)-INT(BY*365.25)
130 REM OUTPUT A HEADING
140 LPRINT"BIORHYTHM CHART FROM";TD;"-";TM;"-";TY;"FOR 30 DAYS"
150 LPRINT
160 REM SET UP THE PLOTTING ARRAY
170 FOR GX=1 TO 80
180 FOR GY=0 TO 29
190 IF GX=39 THEN PL$(GY)=PL$(GY)+"+" : GOTO 210
200 PL$(GY)=PL$(GY)+" "
210 NEXT GY,GX
220 FOR CU=1 TO 3
230 REM SELECT THE APPROPRIATE CURVE
240 IF CU=1 THEN MA$="M" : LE=33 : GOTO 270
250 IF CU=2 THEN MA$="E" : LE=28 : GOTO 270
260 MA$="P" : LE=23
270 OF=EL-INT(EL/LE)*LE
280 FOR GY=0 TO 29
290 PL$(GY)=LEFT$(PL$(GY),39+INT(SIN((OF+GY)/LE*6.283)*39))
    +MA$+RIGHT$(PL$(GY),4
0-INT(SIN((OF+GY)/LE*6.283)*39))
300 NEXT GY,CU
310 REM NOW PRINT THE CHART OUT
320 FOR GY=0 TO 29
330 LPRINT
340 LPRINT PL$(GY)
350 NEXT GY
360 LPRINT
370 END
```

Fig. 4. A typical biorhythm program is given in BASIC.

```
PROGRAM BIORHYTHM(INPUT,OUTPUT,LP);

(* PASCAL TO PLOT BIORHYTHM GRAPHS FOR ANY 30 DAYS *)

CONST EMOLENGTH=28;    PHYSLENGTH=23;  MENTLENGTH=33;
      LINEWIDTH=80;    DAYSPLOTTED=30; EMPTY=' ';
      PHYSMARK='P';    EMOMARK='E';    MENTMARK='M';
      CENTREMARK='+'; TWOPI=6.283;    CENTRELINE=39;
      MARCH=3;

TYPE  DATE=RECORD
        DAY: 1..31;
        MONTH: 1..14;
        YEAR: 0..99;
      END;
VAR   BIRTH,THIS: DATE;
      CURVE: 1..3; (* NUMBER OF CURVE *)
      OFFSET,LEN: 0..MENTLENGTH;
      GRAPHY: 1..DAYSPLOTTED;
      GRAPHX: 1..LINEWIDTH;
      ELAPSED: INTEGER;
      PLOTS: ARRAY[ 1..LINEWIDTH,1..DAYSPLOTTED ] OF CHAR;
      MARK: CHAR;

BEGIN
  WRITE('ENTER YOUR DATE OF BIRTH (E.G. 10 3 61) ');
  READ(BIRTH.DAY,BIRTH.MONTH,BIRTH.YEAR);
  WRITE('NOW ENTER THE CURRENT DATE IN THE SAME FORMAT ');
  READ(THIS.DAY,THIS.MONTH,THIS.YEAR);
  (* WORK OUT THE NUMBER OF DAYS ELAPSED SINCE 1900 *)
  IF THIS.MONTH < MARCH THEN BEGIN
    THIS.YEAR:=THIS.YEAR-1; THIS.MONTH:=THIS.MONTH+12
  END;
  ELAPSED:=THIS.DAY+ROUND((THIS.MONTH+1)*30.6)+
    ROUND(THIS.YEAR*365.25);
  (* SUBTRACT THE NUMBER OF DAYS PRECEDING USER'S BIRTH *)
  IF BIRTH.MONTH < MARCH THEN BEGIN
    BIRTH.YEAR:=BIRTH.YEAR-1; BIRTH.MONTH:=BIRTH.MONTH+12
  END;
  ELAPSED:=ELAPSED-BIRTH.DAY-ROUND((BIRTH.MONTH+1)*30.6)-
    ROUND(BIRTH.YEAR*365.25);
  (* OUTPUT A HEADING *)
  WRITELN(LP,'BIORHYTHM CHART FROM',THIS.DAY,'-',
    THIS.MONTH,'-',THIS.YEAR,'FOR 30 DAYS');
  WRITELN(LP);
  (* SET UP THE PLOTTING ARRAY *)
  FOR GRAPHX:=1 TO LINEWIDTH DO
    FOR GRAPHY:=1 TO DAYSPLOTTED DO
      IF GRAPHX=CENTRELINE
        THEN PLOTS[ GRAPHX,GRAPHY ]:=CENTREMARK
        ELSE PLOTS[ GRAPHX,GRAPHY ]:=EMPTY;
  FOR CURVE:=1 TO 3 DO
  BEGIN
    (* SELECT THE APPROPRIATE MARKER CHARACTER *)
    CASE CURVE OF
      1: BEGIN MARK:=MENTMARK; LEN:=MENTLENGTH END;
      2: BEGIN MARK:=EMOMARK;  LEN:=EMOLENGTH  END;
      3: BEGIN MARK:=PHYSMARK; LEN:=PHYSLENGTH END
    END;
    OFFSET:=(ELAPSED MOD LEN)-1;
    FOR GRAPHY:=1 TO DAYSPLOTTED DO
      PLOTS[ CENTRELINE+ROUND(SIN((OFFSET+GRAPHY)/LEN
        *TWOPI)*CENTRELINE)+1,GRAPHY ]:=MARK
  END;
  (* NOW PRINT THE CHART OUT *)
  FOR GRAPHY:=1 TO DAYSPLOTTED DO
  BEGIN
    WRITELN(LP);
    FOR GRAPHX:=1 TO LINEWIDTH DO
      WRITE(LP,PLOTS[ GRAPHX,GRAPHY ]);
    WRITELN(LP)
  END;
  WRITELN(LP)
END.
```

Fig. 5. The Pascal equivalent of the biorhythm program given in Fig. 4.

options depending upon the value of a variable. In BASIC the ON...GOSUB or ON...GOTO statement can be used to decide between the options, but most programmers tend to use a series of IF tests instead because of the way an ON...GOSUB breaks up the flow of a program. Lines 230-260 of the BASIC illustrate this principle. Pascal has an instruction to get around this problem, as you can see from Fig. 5.

The Pascal CASE statement can be used like a normal IF instruction:

```
CASE LETTER OF
   'A','B': BEGIN WRITELN('WELL DONE'); MARK:=TOP END
END;
```

works exactly the same as:

```
IF LETTER IN ('A','B') THEN
   BEGIN WRITELN('WELL DONE');MARK:=TOP END;
```

Notice that the CASE statement is terminated by an 'extra' END which doesn't correspond to a BEGIN. The CASE marks the start of a section of the program, and the END is used to mark the end of that section. The advantage of CASE over IF is that you can collect lots of IFs together with a CASE statement. Consider the example of set comparison which we used earlier:

```
IF PERCENTAGE IN (40..59) THEN WRITE('PASS')
   ELSE IF PERCENTAGE IN (60..89) THEN WRITE ('MERIT')
      ELSE IF PERCENTAGE IN (90..100) THEN WRITE ('CHEAT!')
```

This example can now be re-written as:

```
CASE PERCENTAGE OF
   40..59: WRITE('PASS');
   60..89: WRITE('MERIT');
   90..100: WRITE('CHEAT!')
END;
```

which is easy to type in and understand. The comparison values may be sets, lists separated by commas, or individual characters or numbers, and there is no limit to the number of categories into which the values may be split. If the value of the variable doesn't fall into any of the categories execution of the program continues after the END of the CASE. If you duplicate values you will receive an error message when you try to compile your program.

The rest of BIORHYTHM should be fairly easy to understand if you compare it with the BASIC listing. The programs produce identical printed output. LPRINT is used from BASIC to direct output to the printer, while Pascal printer output is written to LP (the standard name for the printer port in my version of Pascal). Other dialects of BASIC or Pascal may require slightly different instructions to be used.

THE USUAL PROCEDURE

So far all the example programs used in this series have been fairly short. In fact the length has been typical for Pascal — if a program gets any bigger then it's normal to chop it up into little bits. Next month's article will illustrate the simple way that you can add new words to Pascal. Don't miss our ultra-fast function to find the answer to Life, the Universe and Everything, plus a few more useful instructions!

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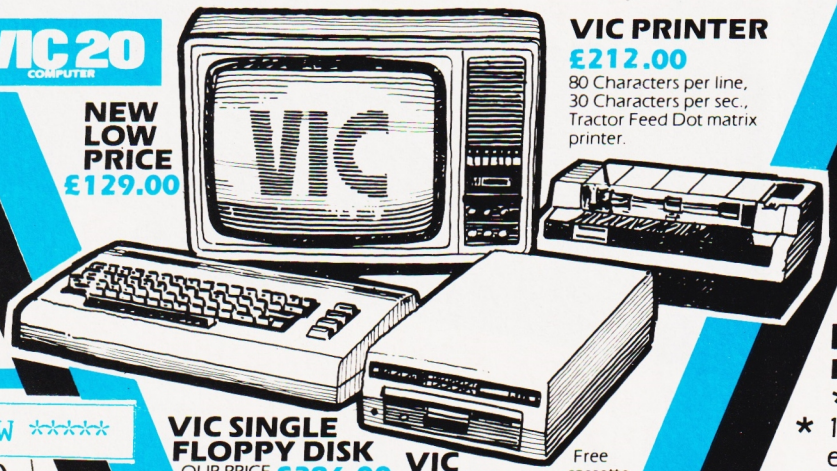

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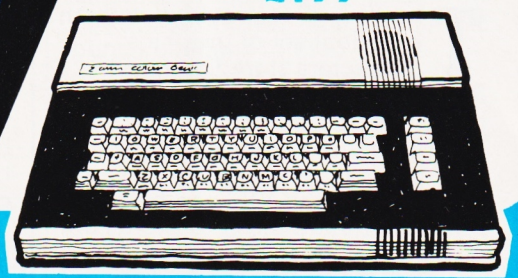

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TAILORING VIC'S CHARACTERS

In last month's issue we showed how the VIC constructed its character set. This month we present a utility program that allows you to create your own symbols.

The VIC-20 is provided with an excellent set of graphics characters stored within its ROM. But like all the best of today's micros the VIC is not limited to just these 'off-the-peg' characters. The character generator on the VIC can be redefined, enabling it to produce a virtually limitless set of 'user-created' character shapes, like 'proper' Space Invaders, Lunar landers, tanks, Pacmen(?) and even people.

Whilst the creation of user-defined characters is not especially difficult, the processes involved can be extremely tedious, usually requiring copious quantities of squared graph paper and furious thumbing of pocket-calculator buttons.

This program provides you with a high-resolution, on-screen character editor, together with automatic calculation of the POKE values of the new character for incorporating into other programs. Furthermore, a shape defined within the boundaries of just one character position is bound to be somewhat limited. The program is therefore arranged to work on a 2 by 2 character matrix, characters being formed within 1, 2, 3, or 4 character positions.

EIGHT TO GENERATE

But let us first quickly recap on how the VIC's character generator works. Each character that the VIC can PRINT can be considered as being made up of eight horizontal rows of eight pixels per row. Each row of pixels is defined in a separate address in memory, which contains the information as to which of the eight pixels in the row will be 'set', and which will be 'not set'.

These 'row-addresses' will contain a binary number with a value between 00000000 and 11111111, ie between 0 and 255. The pattern of 1's and 0's that this binary number represents is directly related to the pattern of pixels 'set' and 'not set' in the row. This is illustrated in Fig. 1.

Since each full character is made up of eight rows of pixels, the complete character shape can be defined by the numbers stored in eight consecutive row-addresses. The block of addresses used for holding the shape information for the whole character set is normally referred to as the 'character generator'. On the VIC-20 this is located in ROM starting at address 32768. Thus, the POKE code 0 (an '@' symbol) uses the information in addresses 32768 to 32775; code 1 (an 'A' uses) addresses 32776 to 32783, and so on.

However, there is essentially no difference between an address containing character shape information and any other address. All are eight bits wide, all will contain numbers between 0 and 255, so any of them could be used

to represent one row of pixels. We cannot change the ROM character generator itself, but if we can tell the VIC to refer to a new series of addresses for its character shape information — an area in RAM which we can change — then we have the ability to define our own character shapes.

Address 36869 is used (amongst other things) as a pointer to the start of the character generator. Normally it contains 240, which is used to point to address 32768. If we change the contents of 36869 we can redirect the VIC to a new character generator start address. For example, POKE 36869,255 will point to a character generator starting at address 7168, a RAM address.

This explanation of the VIC character generator is somewhat over simplified so purists can accept my apologies now. It is nevertheless accurate as far as it goes — more detailed explanations can be found in the **VIC Programmers Reference Guide.**

Having got the VIC to look somewhere else for its character generator all POKE statements to the screen will reference the new row-addresses.

That is:

POKE (any screen address), 0

will use the information in the first eight addresses of the new character generator. Strangely enough, the VIC will still regard character code 0 as an '@' symbol, code 1 as an 'A', etc., so the statement PRINT "@" is still perfectly valid even though the character that appears on the screen looks nothing like an '@'

The VIC will merely assume that by '@' we mean the contents of the first eight addresses of the character generator, regardless of where in memory the character generator is located.

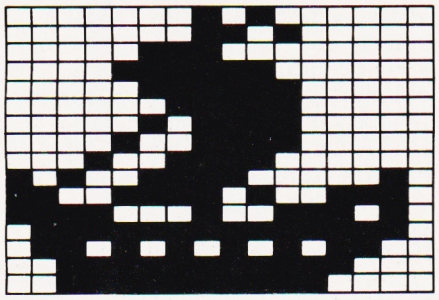

Fig. 2. RN Long range.

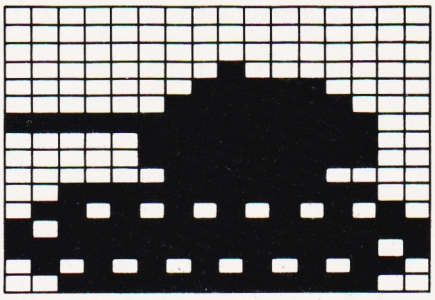

Fig. 3. BAOR firing range.

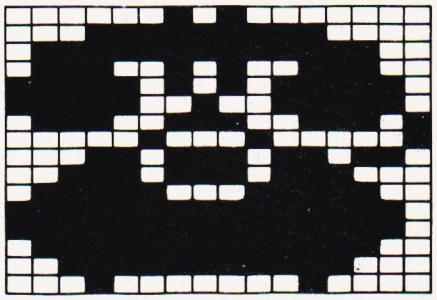

Fig. 4. BT special range.

THE PROGRAM

The program is written in BASIC for the unexpanded VIC-20, and is, as previously stated a 'character editor'.

The main screen display consists of a 16 by 16 'grid' of full size character positions at normal resolution. The grid represents the rows of pixels forming four full characters arranged in the formation:

0 1
2 3

A flashing cursor can be moved around the grid using the normal cursor control keys, and individual elements of the grid can be 'set' using function key f1 or 'unset' using function key f3. This setting or unsetting of elements at normal resolution is reflected at high resolution in an area immediately below the grid. So for every grid element which is set, a single pixel will appear at the bottom of the screen in exactly the same relative location.

Thus, as you move around the main display, turning elements on and off, your actions are mirrored in high resolution — showing you exactly how your finished character will look.

Included in the program are 'paint' and 'unpaint' routines. Paint, called by function key f2, will begin setting each pixel following the current cursor position until either you stop it by pressing any key, or it fills in the whole area remaining. Unpaint — function key f4 — does the reverse, ie it wipes out any pixel already set.

The high resolution character at the bottom of the screen is, in fact, a composite of the first four characters in a new character generator, starting at address 7168. These characters — character POKE codes 0, 1, 2, and 3 or, if you wish, PRINT symbols @, A, B, and C — are arranged on the screen in the same formation as the main grid. Editing the grid causes corresponding changes in the contents of the row-addresses of these characters, and hence changes in their shape.

When you are satisfied with your new character, a read-out of the values now stored in these 32 new row-addresses can be called via function key f8, but since displaying these values will effectively destroy the main grid display, two safety mechanisms are built in. First, the key f8 can only be operated using the SHIFT key at the same time, ie f8 is Shifted f7, so you can't press it accidentally. Secondly, even after f8 has been pressed, the program requires you to 'confirm' your request. If you do nothing, the program will, after a short pause, revert to the normal editing mode with the display intact.

Assuming that you have actually finished editing, and now require a readout of the character shape values, the values will be displayed on the screen in four blocks, each block corresponding to one character in the 2 by 2 ▶

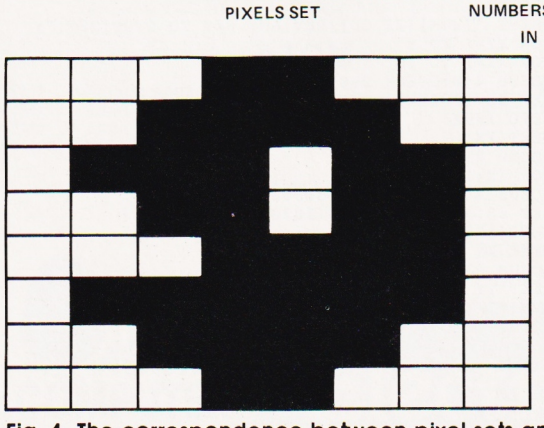

Fig. 1. The correspondence between pixel sets and binary numbers stored in row addresses is illustrated.

matrix. Alongside each block of eight numbers the new character shape formed by them is displayed, and, at the bottom of the screen, the full 2 by 2 character is repeated.

All you have to do now is to record the values displayed for inclusion in your object program. Remember, however, the relative position of each of the individual characters within the 2 by 2 matrix.

ie. 0 1 or @ A
2 3 B C

This must be preserved in your object program.

One method of incorporating the character shape values into a new program is shown below. In this example the shape values of a 2 by 2 character are POKEd into the first 32 addresses of a new character generator starting at 7168. Generally you will want a variety of different characters in your program, so the use of a counter, I, together with a dummy DATA value at the end of the DATA list, 999, enables you to include extra chracters as required without having to worry about the controlling variable in a FOR . . . NEXT loop.

LISTING NOTES

The listing given is for the unexpanded VIC-20, and uses the standard **Computing Today** conventions throughout. All REMs useline numbers ending with a 9 but, in line with standard practice, are not included in program branches and can be safely omitted, together with any non-significant spaces, if desired.

The program could have been compacted quite a lot with further use of subroutines but has been left 'open' for the sake of clarity.

For those of you who don't

```
 10  POKE 56,28:REM ** LOWER RAMTOP TO PROTECT NEW
     CHARACTER GENERATOR
 20  DATA 1,1,7,15,7,3,1,1:REM ** FIRST CHARACTER
 30  DATA 64,160,0,192,224,224,224,224:REM ** SECOND
 40  DATA 3,135,207,241,127,106,63,63:REM ** THIRD
 50  DATA 199,134,14,62,252,172,248,240:REM ** FOURTH
 60  DATA 999:REM ** END OF LIST POINTER
 70  RESTORE
 80  I=0
 90  READ A:IF A=999 THEN 110
100  POKE 7168+I,A:I=I+1:GOTO 90
110  POKE 36869,255:REM ** POINT TO NEW CHARACTER
     GENERATOR AT 7168
120  REST OF PROGRAM ...
```

Fig. 5. A program showing one method of incorporating character shape values.

```
  9  REM ** INITIALISE NEW CHARACTER GENERATOR
 10  POKE 56,28:FOR I=7168+32 TO 7168+39:POKE I,255:NEXT
 20  FOR I=7168 TO 7168+4*8-1:POKE I,0:NEXT
 30  PRINT "[CLS]";:POKE 36869,255
 39  REM ** MAIN DISPLAY
 40  PRINT "[REV][3 SPC]76543210765432107654321076543210"
 50  PRINT "[REV][3 SPC][16 G<@]"
 60  FOR Z=1 TO 2
 70  FOR I=1 TO 8:PRINT "[REV];I;"[CL][G<M][16 SPC]
     [G<G]":NEXT:NEXT
 80  PRINT "[REV][3 SPC][16 G<T][OFF]"
 89  REM ** INITIALISE MAIN VARIABLES
 90  TL=7727:CL=38447:PP=TL:CP=CL:X=1:Y=1:MX=128:DL=100
 99  REM ** PRINT NEW CHARACTERS
100  PRINT "[HOM][19 CD][9 CR]@A[CD][2 CL]BC"
109  REM ** KEYBOARD INPUT
110  GET A$:IF A$="" THEN AP=0:GOSUB 500:GOTO 110
120  AP=0
130  IF A$="[CD]" THEN GOSUB 230:GOSUB 500:GOTO 110
140  IF A$="[CU]" THEN GOSUB 260:GOSUB 500:GOTO 110
150  IF A$="[CR]" THEN GOSUB 290:GOSUB 500:GOTO 110
160  IF A$="[CL]" THEN GOSUB 330:GOSUB 500:GOTO 110
170  IF A$="[F1]" THEN GOSUB 370:GOTO 110
180  IF A$="[F2]" THEN GOSUB 710:GOTO 90
190  IF A$="[F3]" THEN GOSUB 440:GOTO 110
200  IF A$="[F4]" THEN GOSUB 900:GOTO 90
210  IF A$="[F8]" THEN GOSUB 580
220  GOTO 110
229  REM ** MOVE DOWN
230  IF Y>15 THEN RETURN
240  Y=Y+1:AP=22
250  RETURN
259  REM ** MOVE UP
260  IF Y<2 THEN RETURN
270  Y=Y-1:AP=-22
280  RETURN
289  REM ** MOVE RIGHT
290  IF X>15 THEN RETURN
300  X=X+1:AP=1
310  MX=MX/2:IF MX<1 THEN MX=128
320  RETURN
329  REM ** MOVE LEFT
330  IF X<2 THEN RETURN
340  X=X-1:AP=-1
350  MX=MX*2:IF MX>128 THEN MX=1
360  RETURN
369  REM ** SET PIXEL
370  CB=(INT(Y/9)*2)+INT(X/9)
380  IF Y>8 THEN PY=Y-8:GOTO 400
390  PY=Y
400  CV=7168+(CB*8)+PY-1
410  POKE PP,4:POKE CP,0
420  POKE CV,PEEK(CV) OR MX
430  RETURN
439  REM ** UNSET PIXEL
440  CM=(INT(Y/9)*2)+INT(X/9)
450  IF Y>8 THEN PY=Y-8:GOTO 470
460  PY=Y
470  CV=7168+(CB*8)+PY-1
480  POKE PP,160:POKE CV,PEEK(CV)-(PEEK(CV) AND MX)
490  RETURN
499  REM ** FLASHING CURSOR
500  PP=PP+AP:CP=CP+AP
510  RM=PEEK(PP):CM=PEEK(CP)
520  POKE PP,4:POKE CP,5
530  FOR I=1 TO DL:NEXT I
540  POKE PP,RN:POKE CP,CM
550  FOR I=1 TO DL:NEXT I
560  AP=0
570  RETURN
579  REM ** OUTPUT CHARACTER DATA
580  PRINT "[HOM][22 CD][REV]CONFIRM-ANY KEY![OFF]";
590  CF=0
600  CF=CF+1:IF CF>300 THEN PRINT "[HOM][22 CD][REV]
     [19 SPC][OFF]";:RETURN
610  GET CF$:IF CF$="" THEN 600
620  PRINT "[CLS]"
630  FOR I=0 TO 7:PRINT "[REV]";TAB(2);PEEK(7168+I);
     TAB(14);PEEK(7168+I+8):NEXT:PRINT
640  FOR I=16 TO 23:PRINT "[REV]";TAB(2);PEEK(7168+I);
     TAB(14);PEEK(7168+I+8):NEXT:PRINT
650  PRINT "[HOM][4 CD][CR]@[11 CR]A"
660  PRINT "[HOM][13 CD][CR]B[11 CR]C"
670  PRINT "[5 CD][9 CR]@A[CD][2 CL]BC"
680  PRINT "[CD][REV]TYPE 'C' TO CLEAR";
690  GET CC$:IF CC$="" THEN 690
700  PRINT "[CLS]":POKE 36869,240:END
709  REM ** PAINT
710  DL=10
720  PRINT "[HOM][22 CD][REV]ANY KEY TO STOP[OFF]";
730  FOR YY=1 TO 8
740  FOR XX=1 TO 16
750  GOSUB 370:GOSUB 290:GOSUB 500
760  GET Z$:IF Z$="" THEN 780
770  GOTO 870
780  NEXT XX
790  GOSUB 230:GOSUB 500
800  FOR XX=1 TO 16
810  GOSUB 370:GOSUB 330:GOSUB 500
820  GET Z$:IF Z$="" THEN 840
830  GOTO 870
840  NEXT XX
850  GOSUB 230:GOSUB 500
860  NEXT YY
870  DL=100
880  PRINT "[HOM][22 CD][REV][17 SPC][OFF]";
890  RETURN
899  REM ** UNPAINT
900  DL=10
910  PRINT "[HOM][22 CD][REV]ANY KEY TO STOP[OFF]";
920  FOR YY=1 TO 8
930  FOR XX=1 TO 16
940  GOSUB 440:GOSUB 290:GOSUB 500
950  GET Z$:IF Z$="" THEN 970
960  GOTO 1060
970  NEXT XX
980  GOSUB 230:GOSUB 500
990  FOR XX=1 TO 16
1000 GOSUB 440:GOSUB 330:GOSUB 500
1010 GET Z$:IF Z$="" THEN 1030
1020 GOTO 1060
1030 NEXT XX
1040 GOSUB 230:GOSUB 500
1050 NEXT YY
1060 DL=100
1070 PRINT "[HOM][22 CD][REV][17 SPC][OFF]";
1080 RETURN
```

Listing 1. A program for character generation on the unexpanded VIC-20.

have a VIC, the following notes should enable the program to be converted to other machines with a similarly organized character generator.

POKE 56,28 lowers the top of RAM to protect a character generator starting at 7168.

The VIC's screen display comprises 23 rows of 22 character positions per row, giving 506 positions in all. The screen is mapped into two separate areas of memory:

1) 7680 to 8185 is used to hold the code for each character displayed.
2) 38400 to 38905 hold the colour code for each character displayed.
(I'm oversimplifying again but it's close enough)
Thus, POKEing any character onto the screen requires two separate instructions:

POKE 7680,1 : POKE 38400,0

causes a black letter 'A' to be displayed at the top left corner of the screen requires two separate for 'A', and 0 being the colour code for Black.

The characters shown as printed in Reverse video in the listing do not actually appear in their reverse form. Without going into details, this particular location of character generator enables normal resolution and high resolution character (Yes, I know they're both high resolution really) to be mixed on the same screen without copying from the ROM character generator into the new one. You simply PRINT the normal characters in their reversed form — handy eh?

The graphics characters listed in standard **CT** format are:

Line 50 G @ is a horizontal bottom bar. (▁)
Line 70 G M is a vertical right-hand bar. (▕)
G G is a vertical left-hand bar. (▏)
Line 80 G T is a horizontal top bar. (▔)

Finally, I have included some of my own masterpieces using the program. Sorry about the rather feeble joke in the titles — I just wanted to give British Telecom's Special Range phones a plug, (PUN).

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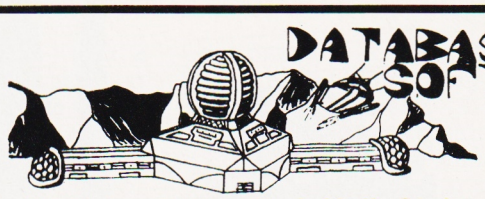

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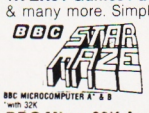

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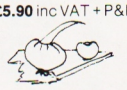

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ATN	LEN	FOR	TIME	UNPLOT	CRF
SIN	MCH	NEXT	WAIT	COLOUR	MEM
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A C Ellis

NASCOM FIND

Searching through a BASIC program for a given command or function by hand can be a time consuming business so, why not let the computer do it for you?

It all started with a listing for a well-known space game. I was told that it would run on my machine with only a little modification, and since it was some 17K long, this was good news. So I typed it in and started to correct my errors and alter the program to suit my machine. While I was doing this I decided that a FIND Mode would be useful, to say the least (just how many places can DIM A hide in 17,000 bytes). So the game was placed to one side while I delved into the NASCOM. The program I came up with is the union of two well-known concepts, they are:

1) The ability to change NAS-SYS-1.

2) The way BASIC files are held and used in memory.

WHAT DOES IT OFFER?

When the program has been inserted into the operating system, the following features are available by typing a Control F in the first character position. The prompt:

```
Find what ?
/
```

will appear. Type in the string you wish to see all occurences of, followed by a "/" then Carriage Return:

```
Find what ?
/GOTO 240/ CR
```

If you have entered FIND Mode without meaning to, just type "/" to the prompt and then Carriage Return. This will put you back into command level BASIC:

```
Find what ?
// CR
_
```

If you omitted any of the "/"s then the machine will respond with:

```
Delimiting Error

Find what ?
/_
```

and retype your string (maximum length is one screen line long). This part of the program uses the old INLIN routine and hence all the NAS-SYS screen editing features are available.

The next thing to appear on the screen could be one of three things.

1) A line of BASIC containing the string you stated. If no cursor is visible, you are still in FIND Mode, and to exit the search, press Escape. Any other key will continue the scan.

2) The message:

```
Search completed
```

means that the search has terminated and you have returned to BASIC's command level. If you get this message in response to your initial string input, then it either does not exist in the program or there is no BASIC program loaded.

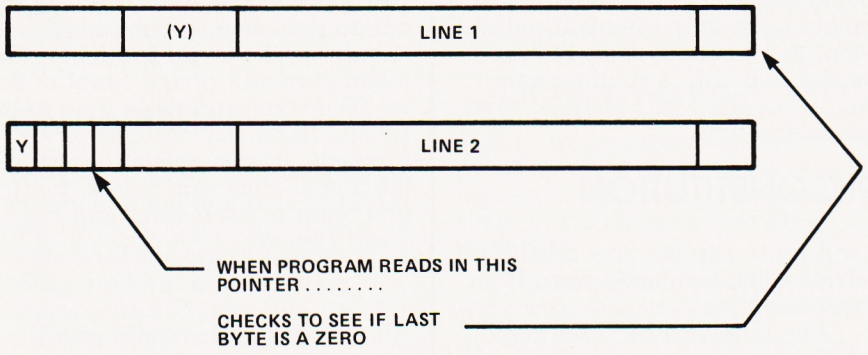
3) The third possible reply could be bad news as this program does a partial check on the format of the BASIC file in store. In fact, it tests that the BASIC line end of 00 Hex is in the byte before the first byte containing the pointer to the next line.

If this test fails then the BASIC file is corrupt and will not either RUN or LIST. If this is the case, then the message given below will appear:

```
Format Error

at  ****
Search completed
_
```

This informs you of the error and gives you the absolute address (* * * *) of the start of the line to come. Finally, it terminates the search and returns to BASIC command level. Do not run the program at this stage as it will crash the system if the pointer ' * * * * ' is at fault. Instead, go into the monitor and do the necessary 'surgery' around the given link to restore the data format. This may save your



Lines of BASIC are stored as a series of linked segments of code, each line containing a pointer to the start of the next line. If the pointer contains 00 then the end of the program has been reached.

program.

So, if your favourite games tape should decide to be over-generous with drop-outs, provided you only load it into BASIC then use FIND without listing or running the program and you may be able to patch it up.

Remember that it searches for a literal string, so if you type in /REM/ both the lines below would be detected:

```
200  REM ** TEST ONE
210  PRINT "MISSILES REMAINING"
```

Remember that spaces within the string are significant and there is a difference between upper and lower case characters. For example:

```
/ PRINT/
```

will miss:

```
10print
100PRINT
```

Due to size restrictions and limited information about Microsoft BASIC v4.7, the program is not as fast as it could be. This is because I have had to 'go around' some problems. But even so, it will search a 17K program for a string, given only at the end, in four to five seconds — try doing that manually!

One last thing, if you try to access FIND Mode when it is in the operating system, but on a program other than BASIC, the message shown below will appear.

```
NOT IN BASIC
```

The indentation of the message was to overcome the fact that if you are in ZEAP, it thinks it is the N command and consequently goes to NAS-SYS-1.

HOW IT DOES IT

My apologies to those familiar with BASIC file storage and the method of altering NAS-SYS, but I repeat them since some new ground is covered in the linking of the two methods. I could do no better than suggest reading W S Lound's article in *Computing Today* (NASCOM's BASIC, page 56, March 1981). But for those without that copy, here follows a brief summary.

The program is stored in a list (format given below) from 10F9 Hex upwards. A pointer at 105E Hex holds the start of the BASIC file.

All the reserved words are held in token form. This compression takes place in a buffer from 1061 Hex upwards, the line of data coming from the screen and then going to the main program store.

The end of the program is denoted by the pointer to the next line holding 00 Hex.

NAS-SYS-1 can be altered by changing the pointer called STAB to point to a new command table which we copy from the old ROM-based one into RAM — and then modifying the pointers to the routines we wish to alter. These routines must also be in RAM.

To change the way the operating system works, we need to run a small program (in this case at D2E Hex) which will do our alterations. Since NAS-SYS rewrites its workspace during initial restarts it resets STAB, so you will need to run from D2E Hex again to restore FIND Mode after a system reset.

JOINING UP

The basics are over and done with, now we come to the joining of the two main ideas. Since part of the program uses a routine in BASIC which outputs to the screen and buffer the ASCII decimal of a Hex value held in the HL register pair (brought to my attention by Tony Watkins' article in *Computing Today* called NASCOM Renumber (January 1981, p16), and Graham Smith's letter in *Computing Today* March 1981, p67). But for this routine to work, the BASIC workspace must be intact. So, the need came about for a method to detect that we are in BASIC. In my program it is done by looking at the return address for the INLIN subroutine (the INLIN routine is used to hold FIND Mode). This must be FEEA Hex if the return is to BASIC's command level.

The other reasons for using INLIN to hold the FIND Mode are listed below:

1) The method of getting BASIC command level lines must be different from the routine for INPUT statements. Suddenly getting 'Find what?' in the middle of your game is not on!
2) The method of obtaining command level lines is non-interactive with BASIC.

Solving these problems respectively, the command level lines use the monitor routine INLIN (DF63 Hex). Its location in the subroutine table is at 7CC Hex, pointing to the start of the routine at 02B5 Hex.

The only clue to the INPUT instruction was given on page 11, issue two of the BASIC manual under the heading 'Additional commands section I'. It deals with various formats of the INPUT statement, all of which changed a pointer at 4175. Since −6649 restored normal operation, let's have a look at this address in the BASIC ROM.

The routine at this location services the INPUT statement and it does not use INLIN, it uses BLINK instead and provides its own edit facilities, etc.

The routine called INLIN is self-contained, only returning on receipt of a Carriage Return, with DE pointing to the start of the line (DE must be set to point to a blank line when output from FIND Mode was needed, to avoid a SN Error).

So, now our way is clear to write our FIND Mode as part of INLIN.

HOW TO GO A' SEARCHING

I was left with a decision. The quickest method to find a string in the BASIC file was to take the required string, compress it, and then look for its compressed form in the file, reconstituting only the BASIC lines which held the string.

This was not to be, two things were against me. One was that I could not find the BASIC command line compression routine (even if it would have worked in my program without giving errors, ▶

I was still left with the problem of space). The program was to use the space between 0C80 and 0F00 Hex, since BASIC has no effect upon this portion of memory. So, even if I could have used the above routine, I would still have needed a method of reconstituting the BASIC line in order to display it.

It was these factors that led me to using the slower method of making up each BASIC line and then testing if the string was present. If it was present, then I displayed it simply by copying it from the buffer BASSTR to the screen.

The reason for the subroutines RECONS, DISPLY and COMPRE being used, instead of their function being in the main search loop, is so that anyone who has access to BASIC's routines can simply modify FIND Mode to save space and time.

RECONSTITUTION

I will try to explain how BASIC retrieves the command word from the token byte.

Any byte with bit 7 set in a BASIC file line represents a reserved word — hence the listing of graphics gives some strange results. So we now scan along the line until a bit 7 is found to be set. We then take the token byte and strip bit 7 from it, and after adding one to the value, it becomes a counter to the command table, ie a token of 84 will give a count of 5.

The command table lives in the BASIC ROM from E143 Hex upwards. Its contents are a list of the actual command words, but the first letter of each command has bit 7 set. Hence:

```
FOR = C6 4F 52
```

All we have to do now is scan down through the list decrementing our count every time we pass a byte with bit 7 set until we get a count of zero. This is the command word that we want. To

Program Listing

```
                ;*****************************************
                ; Find mode for BASIC using modified INLIN
                ; 4/1/82        rev 1.4      A.C.ELLIS
                ;*****************************************



0C80            PSTART ORG  0C80H
0C80 105E       START  EQU  0105EH
0C80 0BFE       TSTART EQU  PSTART-"A-"A
0C80 0C29       CURSOR EQU  0C29H
0C80 E143       BTABLE EQU  0E143H
0C80 F9AD       HTOA   EQU  0F9ADH
0C80 001B       ESCAPE EQU  01BH
0C80 10AB       COUNT  EQU  010ABH
0C80 1061       BASSTR EQU  01061H

                ;Workspace

0C80 0078       TABLE  DEFS 078H
0CF8 0030       FINSTR DEFS 030H
0D28 0002       POSITN DEFS 2
0D2A 0002       NEXLIN DEFS 2
0D2C 0002       CLINO  DEFS 2

                ;Move and alter command table

0D2E                   ENT
0D2E 218807            LD   HL,0788H
0D31 11800C            LD   DE,PSTART
0D34 017800            LD   BC,078H
0D37 EDB0              LDIR
0D39 21710C            LD   HL,0C71H
0D3C 11FE0B            LD   DE,TSTART
0D3F 73                LD   (HL),E
0D40 23                INC  HL
0D41 72                LD   (HL),D ;New STAB

                ;Load new INLIN adds. in table

0D42 214A0D            LD   HL,INLIN
0D45 22C40C            LD   (TSTART+063H+063H),HL
0D48 DF5B              SCAL 05BH
0D4A C1         INLIN  POP  BC
0D4B C5                PUSH BC ;Get return adds in BC
0D4C E5                PUSH HL
0D4D 2A290C            LD   HL,(CURSOR)
0D50 22280D            LD   (POSITN),HL
0D53 DF7B       INL2   SCAL 07BH ;Blink
0D55 FE06              CP   06H
0D57 C26F0E            JP   NZ,PCNTF1 ;Char. not control F
0D5A 2A290C            LD   HL,(CURSOR)
0D5D ED5B280D          LD   DE,(POSITN)
0D61 ED52              SBC  HL,DE ;Need'nt reset carry as A=06
0D63 C26F0E            JP   NZ,PCNTF1 ;Control F not in 1st col.
0D66 AF                XOR  A ;Test to see if INLIN was called
0D67 21EAFE            LD   HL,0FEEAH ;from BASIC
0D6A ED42              SBC  HL,BC
0D6C 2817              JR   Z,PASMES
0D6E DF6A       NBASIC SCAL 06AH
0D70 EF                RST  028H
0D71 204E4F54          DEFM / NOT IN BASIC./
     20494E20
     42415349
     432E
0D7F 00                DEFB 0
0D80 DF6A              SCAL 06AH
0D82 C3750E            JP   END
0D85 DF6A       PASMES SCAL 06AH
0D87 EF                RST  028H
0D88 46696E64          DEFM /Find what ?/
     20776861
     74203F
0D93 00                DEFB 0
0D94 DF6A              SCAL 06AH ;cr/lf
0D96 3E2F              LD   A,"/
0D98 F7                RST  030H
0D99 CDB502            CALL 02B5H ;The old inlin routine
0D9C D5                PUSH DE
0D9D 0630              LD   B,48
0D9F 1A         TESFR  LD   A,(DE)
0DA0 FE2F              CP   "/
0DA2 2805              JR   Z,PASFR
0DA4 13                INC  DE
0DA5 10F8              DJNZ TESFR ;Test for first /
0DA7 1809              JR   ERRM
0DA9 13         PASFR  INC  DE
0DAA 1A         TESND  LD   A,(DE)
0DAB FE2F              CP   "/
0DAD 2817              JR   Z,PASND
0DAF 13                INC  DE
0DB0 10F8              DJNZ TESND ;Test for second /
0DB2 DF6A       ERRM   SCAL 06AH
0DB4 EF                RST  028H
0DB5 44656C69          DEFM /Delimiting /
     6D697469
     6E6720
0DC0 00                DEFB 0
0DC1 DF6B              SCAL 06BH ;Errm
0DC3 D1                POP  DE
0DC4 18BF              JR   PASMES
0DC6 E1         PASND  POP  HL ;when't on as DE
0DC7 7E         LP1    LD   A,(HL)
0DC8 FE2F              CP   "/
0DCA 2803              JR   Z,LOADIT
0DCC 23                INC  HL
0DCD 18F8              JR   LP1 ;Test loop to find first /
0DCF 23         LOADIT INC  HL
0DD0 E5                PUSH HL ;Save start adds. of FINSTR
0DD1 010000            LD   BC,0
0DD4 7E         LP2    LD   A,(HL)
0DD5 FE2F              CP   "/
0DD7 2804              JR   Z,OUTLP
0DD9 03                INC  BC
0DDA 23                INC  HL
0DDB 18F7              JR   LP2
0DDD 11F80C     OUTLP  LD   DE,FINSTR
0DE0 E1                POP  HL
0DE1 78                LD   A,B
0DE2 B1                OR   C
0DE3 2005              JR   NZ,PASOUT ;Test for the // exit
0DE5 DF6A              SCAL 06AH
0DE7 C3750E            JP   END
0DEA EDB0       PASOUT LDIR ;Copy string to workspace
0DEC AF                XOR  A
0DED 12                LD   (DE),A ;Delimit FINSTR
0DEE 2A5E10            LD   HL,(START)
0DF1 1803              JR   GETIN

                ;We can now start the search

0DF3 2A2A0D     NEXT   LD   HL,(NEXLIN)
0DF6 2B         GETIN  DEC  HL ;Check correct BASIC format
0DF7 AF                XOR  A ;i.e. that (NEXLIN-1)=0
0DF8 BE                CP   (HL)
0DF9 23                INC  HL
0DFA 281C              JR   Z,PCORPT
0DFC DF6A              SCAL 06AH
0DFE EF                RST  028H
0DFF 466F726D          DEFM /Format /
     617420
0E06 00                DEFB 0
0E07 DF6B              SCAL 06BH
0E09 EF                RST  028H
0E0A 417420            DEFM /At /
0E0D 00                DEFB 0
0E0E 2A2A0D            LD   HL,(NEXLIN) ;Output absolute adds. of
0E11 DF66              SCAL 066H ;start of current BASIC line.
```

output it we must first correct the initial letter and then copy the table until another byte with bit 7 set is encountered.

COMPARISON

Each BASIC line is searched for an occurence of the first byte of the string FINSTR; the program will search BASSTR byte for byte looping until either a match is found or BASSTR ends.

If a possible match is found then the rest of the string is throughly tested in a loop until either a mismatch is found or the end of FINSTR is found, ie a match is held within BASSTR. If it is not a correct match then the search falls through to the first character comparison, from the place it left off plus one.

The use of the relative jumps in the program was to conserve space, as opposed to making the program relocatable; it may be moved (if you have an assembler) simply by changing the ORG statement.

The program was designed to work with reconstituted lines not greater than two screen lines in length. This is quite long and I have never had any need to pack a BASIC line of that length.

The BASSTR reconstituted BASIC line) is stored in the BASIC buffer (1061 Hex) upwards since it is not used during FIND Mode, and it frees 60 Hex bytes for the program.

Routine	Function	Length
TABLE	Copy of the NAS-SYS-1 command table.	78 Hex bytes
FINSTR	The string we are searching the BASIC file for.	30 Hex bytes
POSITN	The address of the first byte of INLIN.	02 Hex bytes
NEXLIN	Pointer to start of next line.	02 Hex bytes
CLINO	Hex value of the current line number.	02 Hex bytes

The NASCOM Find program uses a number of storage areas for holding the BASIC command tables etc.

Program Listing

```
0E13 DF6A              SCAL 06AH
0E15 C3540E            JP   ENDMES
0E18 AF        PCORPT  XOR  A
0E19 7E                LD   A,(HL) ; If pointer to next line=0000
0E1A 23                INC  HL
0E1B B6                OR   (HL) ;then jump to end of search
0E1C 2B                DEC  HL
0E1D 2835              JR   Z,ENDMES
0E1F 5E                LD   E,(HL)
0E20 23                INC  HL
0E21 56                LD   D,(HL)
0E22 ED532A0D          LD   (NEXLIN),DE ;adds.to next line in WKS
0E26 23                INC  HL
0E27 5E                LD   E,(HL)
0E28 23                INC  HL
0E29 56                LD   D,(HL)
0E2A ED532C0D          LD   (CLINO),DE
0E2E 23                INC  HL
0E2F 116110            LD   DE,BASSTR ;set pointer to start BASSTR
0E32 7E        EXMINE  LD   A,(HL)
0E33 B7                OR   A
0E34 280F              JR   Z,LINEND ;Test if current line ended
0E36 CB7F              BIT  7,A
0E38 2806              JR   Z,PASREC ; ie.char.is not a token
0E3A CD7F0E            CALL RECONS
0E3D 23                INC  HL
0E3E 18F2              JR   EXMINE
0E40 12        PASREC  LD   (DE),A ;Put char. into BASSTR
0E41 23                INC  HL
0E42 13                INC  DE
0E43 18ED              JR   EXMINE
0E45 12        LINEND  LD   (DE),A ;Store end 0 in BASSTR

                       ;We now have a full BASIC line in BASSTR
                       ;with the hex of it's line number in
                       ;CLINO we can now do the string test

0E46 216110            LD   HL,BASSTR
0E49 11F80C            LD   DE,FINSTR
0E4C CDD10E            CALL COMPRE
0E4F DCA10E            CALL C,DISPLY
0E52 189F              JR   NEXT
0E54 EF        ENDMES  RST  028H
0E55 53656172          DEFM /Search completed./
     63682063
     6F6D706C
     65746564
     2E
0E66 00                DEFB 0
0E67 DF6A              SCAL 06AH
0E69 ED5B290C          LD   DE,(CURSOR)
0E6D E1                POP  HL
0E6E C9                RET
0E6F F7        PCNTF1  RST  030H ;Continuation of INLIN
0E70 FE0D              CP   0DH
0E72 C2530D            JP   NZ,INL2
0E75 2A290C    END     LD   HL,(CURSOR)
0E78 11C0FF            LD   DE,-64
0E7B 19                ADD  HL,DE
0E7C EB                EX   DE,HL
0E7D E1                POP  HL
0E7E C9                RET
               ;***************************************
0E7F E5        RECONS  PUSH HL
0E80 CBBF              RES  7,A ;Reset MSB of token
0E82 47                LD   B,A
0E83 04                INC  B ;Create table counter
0E84 2143E1            LD   HL,BTABLE
0E87 7E        RLP1    LD   A,(HL)
0E88 CB7F              BIT  7,A
0E8A 2003              JR   NZ,FHIBIT
0E8C 23        RLP2    INC  HL
0E8D 18F8              JR   RLP1
0E8F 05        FHIBIT  DEC  B ;Test if its the word wanted
0E90 78                LD   A,B
0E91 B7                OR   A
0E92 20F8              JR   NZ,RLP2
0E94 7E                LD   A,(HL) ;Correct 1st char.
0E95 CBBF              RES  7,A ;of BASIC reserved word
0E97 12        RLP3    LD   (DE),A
0E98 13                INC  DE ;Move pointer in BASSTR
0E99 23                INC  HL ;Move pointer in TABLE
0E9A 7E                LD   A,(HL)
0E9B CB7F              BIT  7,A
0E9D 28F8              JR   Z,RLP3 ;Loop the rest of word to buff.
0E9F E1                POP  HL
0EA0 C9                RET

0EA1 AF        DISPLY  XOR  A ;Reset BASIC char. counter
0EA2 32AB10            LD   (COUNT),A
0EA5 2A2C0D            LD   HL,(CLINO)
0EA8 CDADF9            CALL HTOA ;Put up line number
0EAB 3E20              LD   A,020H
0EAD F7                RST  030H
0EAE 116110            LD   DE,BASSTR
0EB1 1A        DISLP   LD   A,(DE)
0EB2 FE00              CP   0
0EB4 2812              JR   Z,CONT0
0EB6 2A290C            LD   HL,(CURSOR)
0EB9 23                INC  HL
0EBA 47                LD   B,A
0EBB 7E                LD   A,(HL)
0EBC B7                OR   A
0EBD 78                LD   A,B
0EBE 2004              JR   NZ,PCRLF
0EC0 F5                PUSH AF
0EC1 DF6A              SCAL 06AH
0EC3 F1                POP  AF
0EC4 F7        PCRLF   RST  030H  ;Loop to copy BASSTR from
0EC5 13                INC  DE
0EC6 18E9              JR   DISLP
0EC8 DF6A      CONT0   SCAL 06AH
0ECA CF                RST  08H  ;Test for wait and escape
0ECB FE1B              CP   ESCAPE
0ECD C0                RET  NZ
0ECE E1                POP  HL ;Remove the return adds.
0ECF 1883              JR   ENDMES
0ED1 3AF80C    COMPRE  LD   A,(FINSTR)
0ED4 BE                CP   (HL)      ;Test for 1st char match
0ED5 2808              JR   Z,POSFND ;If yes then a possiable find
0ED7 23                INC  HL
0ED8 7E                LD   A,(HL)
0ED9 FE00              CP   0
0EDB 20F4              JR   NZ,COMPRE  ;Check for end of BASSTR
0EDD AF                XOR  A
0EDE C9                RET  ;Return with no match found
0EDF 23        POSFND  INC  HL ;Test on rest of string
0EE0 E5                PUSH HL
0EE1 13        LOOP    INC  DE
0EE2 1A                LD   A,(DE)
0EE3 FE00              CP   0
0EE5 2812              JR   Z,FOUND ;Test loop
0EE7 7E                LD   A,(HL)
0EE8 FE00              CP   0
0EEA 2810              JR   Z,ENDING ;End of BASSTR
0EEC 1A                LD   A,(DE)
0EED BE                CP   (HL)
0EEE 2003              JR   NZ,NMATCH ;Difference found
0EF0 23                INC  HL
0EF1 18EE              JR   LOOP
0EF3 E1        NMATCH  POP  HL ;No match,so restore place
0EF4 11F80C            LD   DE,FINSTR ;in BASSTR and continue
0EF7 18D8              JR   COMPRE
0EF9 E1        FOUND   POP  HL
0EFA 37                SCF
0EFB C9                RET
0EFC E1        ENDING  POP  HL
0EFD AF                XOR  A
0EFE C9                RET
```

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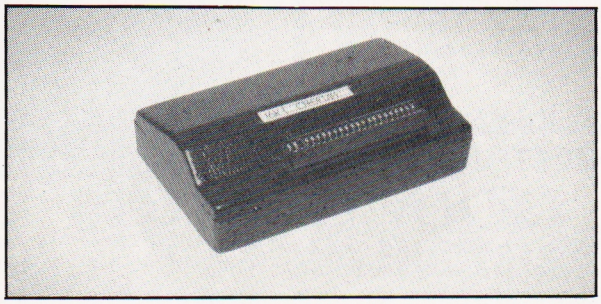

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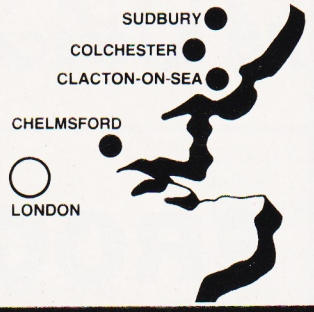

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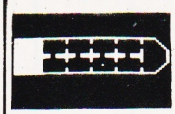

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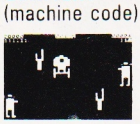

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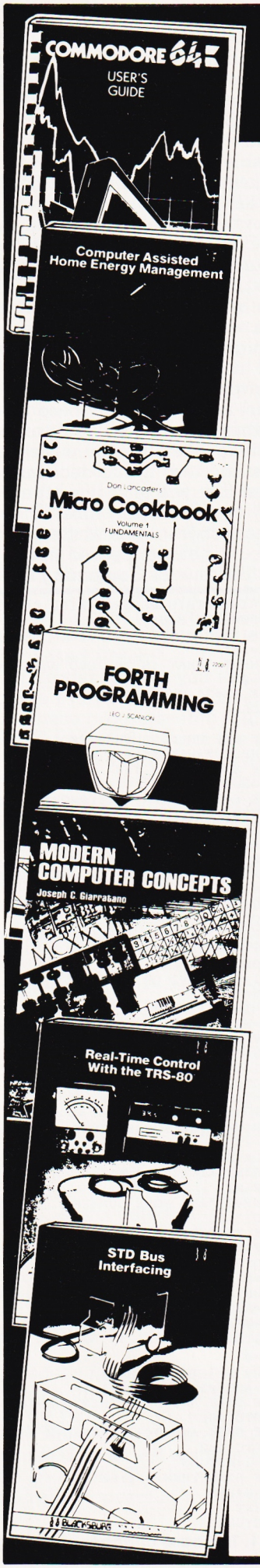

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PEEK AND POKE EXPLAINED

This month our feature on the application of PEEK and POKE turns its attention to loading machine code programs from BASIC.

Last month I endeavoured to show you how to use the PEEK and POKE commands to manipulate the contents of the screen memory in order to create the illusion of moving graphics. At the beginning of the article I mentioned that there were other uses for these two commands, specifically loading machine code programs into the computer and the control of I/O devices.

This month I'm going to look at the first of these two areas and show that it is really quite simple to load a machine code program into your computer, even if you don't understand what it does or how it does it!

GETTING HEXED

Our first problem is that all the machine code programs look so complicated, they seem to come in a wide variety of formats and types so how do you go about deciding whether the program can actually be used in the first place.

Machine code programs are generally published in one of two forms; a Hex dump or an assembly listing. In the first instance, see Fig. 1, all the information we need is presented in the simplest possible form — all we need to know is whether we can actually use it. The second type of listing contains far more information than we actually need, all we require are the addresses and the Hex codes, usually the two left-hand columns as shown in Fig. 2.

So, we can see what we want to get into the computer but how do we go about getting it in? Machine code programs occupy memory in just the same way as BASIC programs and it should be fairly obvious that we cannot have the two programs occupying the same memory space! If the machine code program is described as being 're-locatable' it means that we should be able to load it into any part of the computer's free memory and run it without any trouble.

If, however, this is not the case we must first establish where the program is intended to sit in memory. In general you will find that systems that are equipped with a monitor program, the system program that allows you to directly modify areas of memory and load machine code programs, will have their programs written to occupy the same area of memory as BASIC — simply because the facility exists to load machine code without using BASIC.

Many systems allow you to specify the size of memory available to BASIC; TRS-80s and the Tangerine systems are examples of this approach. The reason that this facility is provided is to enable you to create an area of memory that BASIC cannot get at, just what you need for a machine code program. Programs of this type will often include mentions in the text telling you what value to input to the MEMORY SIZE query.

```
033A   A9  00  85  DA  85  DA  A9  78
0342   85  DC  A9  0E  8D  4C  E8  A9
034A   93  20  D2  FF  A9  80  85  DD
0352   A2  00  BD  8A  03  20  D2  FF
035A   E8  E0  0F  D0  F5  A6  DA  A5
0362   DB  20  9F  DC  A2  01  A0  00
```

Fig. 1. A typical Hex dump of a machine code program. All the necessary information is given in its most basic form.

```
0C50 FE 1F     START:CP A, 1FH
0C52 C2 3B 01        JP NZ,CRT
0C55 F5 C5 D5 E5     PUSH AF, BC, DE, HL
0C59 2A 18 0C        LD HL, CURPOS
0C5C 36 20           LD (HL),' '
0C5E 11 CA 0A        LD DE, OACAH
0C60 21 0A 0B        LD HL, OBOAH
0C63 01 B0 00        LD BC, OBOOH
0C66 C3 9E 01        JP 19EH
```

Fig. 2. An assembly listing contains a great deal of extra information, we're only after the addresses and the op-codes.

The final check to make is to establish the starting address of the machine code program and to see if this is the same as the address that BASIC programs start at. If it is, and the program is not re-locatable you have a problem!

Having established that the program resides in an area of memory that won't be affected by BASIC or that it can be made to do so you have to begin the laborious chore of converting all those Hex codes into decimal. To make this easier — well, a little bit easier — you might like to use the program given in Listing 1. This is a base converter and, as shown, will convert numbers of any base to any other base. As all you want it to do is to take a continuous stream of Hex and turn it into decimal I suggest that you alter it a little, simply to save keying time. The original program was written by Bill Lounds and appeared in the April '81 issue of *Computing Today*.

```
 20  PRINT "THIS PROGRAM WILL CHANGE
     FROM ANY BASE"
 30  PRINT "<=16 TO ANY OTHER BASE
     <=16"
 40  INPUT "WHAT IS THE OLD BASE";X$
 50  E=0
 60  IF X$="" THEN 30
 70  GOSUB 390
 80  B=N
 90  IF N<2 OR N>16 THEN 30
100  INPUT "WHAT IS THE NUMBER";X$
110  IF X$="" THEN 100
120  GOSUB 430
130  IF E=1 THEN PRINT "ERROR":E=0:
     GOTO 100
140  N1=N
150  PRINT X$;" IN BASE 10 IS ";N1
160  IF N1<1000000 THEN 190
170  PRINT "THE NUMBER IN BASE 10 IS
     >=1000000, THIS"
180  PRINT "MEANS THAT ERRORS MAY
     OCCUR"
190  INPUT "WHAT IS THE NEW BASE";X$
200  IF X$="" THEN 190
210  GOSUB 390
220  B1=N:IF N<2 OR N>16 THEN 190
230  B$=""
240  V=INT(N1/B1)
250  R=N1-V*B1
260  IF R>9 THEN 300
270  B$=B$+CHR$(R+48)
280  N1=V:IF V=0 THEN 310
290  GOTO 240
300  R=R+55:B$=B$+CHR$(R):N1=V:
     IF V<>0 THEN 240
310  PRINT "THE NUMBER IN BASE ";B1;
     " IS ";
320  FOR J=LEN(B$) TO 1 STEP-1
330  PRINT MID$(B$,J,1);:NEXT
340  PRINT
350  INPUT "ANY MORE NUMBERS (YES OR
     NO)";X$
360  IF X$="YES" THEN 30
370  IF X$="NO" THEN STOP
380  GOTO 350
390  N=0
400  FOR J=1 TO LEN(X$):
     D=ASC(MID$(X$,J,1))
410  N=N*10+D-48:NEXT
420  RETURN
430  N=0
440  FOR J=1 TO LEN(X$):
     D=ASC(MID$(X$,J,1))
450  IF D>47 AND D<58 THEN D=D-48:
     GOTO 480
460  IF D>64 AND D<71 THEN D=D-55:
     GOTO 480
470  E=1:RETURN
480  IF D>=B THEN E=1:RETURN
490  N=N*B+D
500  NEXT
510  RETURN
```

Listing 1. The base changer program.

INTO BASIC

As we learned last month we can use the POKE command to alter the contents of any given memory location and that's exactly what we want to do here. First we must establish the starting address of the program and the number of bytes that we have to load in. Now all we have to do is to set up a loop where we increment the address over the range from the starting point to the finishing point and POKE the information into each location in turn.

In order to illustrate this I have taken two programs which produce roughly the same result — they reverse the screen — which were written for two different systems. Listing 2 is a 6502 machine code program and is written to run on the PET while Listing 3 is a Z80 code program that will do exactly the same thing on a TRS-80. Don't forget, you must make sure that you are using the right machine code, it's going to be no good loading a Z80 program into a 6502-based system!

In order to save you the trouble I have already converted both these programs into their BASIC format and these are given as Listings 4 and 5 respectively. Note that the instructions for running are given in the programs, you cannot RUN a machine code program as you can a BASIC program. If these two programs seem slightly familiar that's because the Tandy one appeared in July '80 in the Hex Routines article and the PET version was part of Trevor Lusty's Interactive Graphics series which ran from November '80 to January '81... waste not, want not I say!

The PET program is loaded into a rather special area of memory called the Second Cassette Buffer, this is often used to hold small machine code programs as it is seldom used. The Tandy program is POKEd away to the top of the user memory area and the BASIC is prevented from overwriting it by answering the MEM SIZE query with 32512 (assuming that you have a 16K machine).

GETTING IT RUNNING

OK, so it's no great deal to get the program into the machine — but how do you get it to run? Well, in BASIC there are generally two commands that will achieve this; SYS and USR. The former generally appears in the form:

```
SYS(1234)
```

where 1234 is the starting address of the machine code program. In order that the program will return to BASIC when it has finished you should remember to put a RET instruction at the end otherwise it will plough relentlessly on through the rest of the machine's memory haphazardly executing all sorts of rubbish.

The Tandy BASIC loader program uses the USR function rather than the SYS call and this requires that the system be told where the machine code program is located. In this case we store the address in a pair of locations, see line 50, and then when we use the USR function, see line 60, the computer knows where to go.

The PET program is simply executed by a SYS(826) call where 826 is the decimal address of the Second Cassette Buffer. If your program is too big to fit into the Cassette Buffer you will either have to resort to using the monitor program (TIM) to put it in or you'll have to tell BASIC that it has less memory than it expects by altering the pointers in Zero page — something that is more than a little outside the scope of this feature!

USING THE SYSTEM

Storing machine code programs in unused areas of memory with the POKE command is, as I hope you have seen, quite easy to do. However, this is by no means the only other use to which the command can be put. If you know the addresses of any of the monitor routines, and they are often given in either the manual or one of many books that accompany popular systems, you can make use of these by POKEing their addresses into the correct locations in memory and then calling the routine with either a SYS or USR function.

Many systems also contain a number of options that are software selectable, lower case letters on the PET for example. To access these you simply type the following as either a direct command or part of a program:

```
POKE 59468,12 (OR 14)
```

Changing the contents of this memory location swaps the character generator between upper and lower case letters, there are many other examples. Often, if your computer is equipped with communications ports such as an RS232 serial interface, you will find that the baud rates are said to be software selectable. The contents of a particular memory location will determine the speed of transmission and they can be altered by a simple POKE command.

IN CONCLUSION

If you have seen a machine code program that you thought you would never be able to use because you couldn't work out how to get it into your computer then this month's piece should have at least helped. You cannot always use the BASIC loader system, especially in cases where the computer doesn't allow you to establish protected areas of memory, but in general it can be made to work through a little application.

```
033A  A2 80     LDX #$80
033C  86 02     STX SCREEN+1
033E  A9 00     LDA #$00
0340  85 01     STA SCREEN
0342  CA        LOOPA:DEX
0343  A0 00     LDY #00
0345  B1 01     LOOPB:LDA (SCREEN),Y
0347  49 80     EOR #$80
0349  91 01     STA (SCREEN),Y
034B  C8        INY
034C  D0 F7     BNE LOOPB
034E  E6 02     INC 02
0350  E0 7C     CPX #$7C
0352  D0 EE     BNE LOOPA
0354  60        RTS
```

Listing 2. A 6502 machine code program to reverse the screen on a PET. It will be loaded into the unused Cassette Buffer.

```
7F00  21 00 3C      LD HL,3C00
7F03  36 BF         LD (HL),FF
7F05  11 01 3C      LD DE,3C01
7F08  01 FF 03      LD BC,3FF
7F0B  ED B0         LDIR
7F0D  C9            RET
```

Listing 3. The screen reversal program for a TRS-80, the addresses indicate that it will be loaded into memory above BASIC.

```
100  FOR I=826 TO 852
110  READ J
120  POKE I,J
130  NEXT I
140  SYS(826)
150  DATA 162,128,134,2,169,0,133,1,
     202,160,0,177,1,73,128
160  DATA 145,1,200,208,247,230,2,
     224,124,208,238,96
```

Listing 4. The BASIC program that will load the machine code of Listing 2 into the Second Cassette Buffer

```
 5  REM ** DON'T FORGET TO ANSWER
    MEM SIZE WITH 32512
10  DATA 33,0,60,54,255,17,1,60,1,
    255,3,237,176,201
15  REM ** THE DECIMAL EQUIVALENTS
    OF THE OPCODES IN LISTING 4
20  FOR X=32512 TO 32525
25  REM ** START AND FINISH
    ADDRESSES IN PROTECTED MEMORY
30  READ A:POKE X,A
35  REM ** GET A BYTE AND LOAD IT
40  NEXT
50  POKE 16526,0:POKE 16527,127
55  REM ** DEFINE THE ENTRY POINT
    FOR THE SUBROUTINE
60  X1=USR(0)
65  REM ** CALL THE SUBROUTINE
```

Listing 5. The BASIC program to load the machine code of Listing 3 into high memory on the TRS-80. Follow the instructions concerning the MEM SIZE query before you load it!

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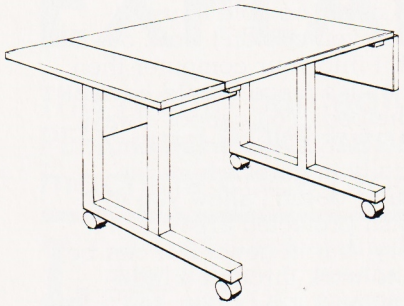

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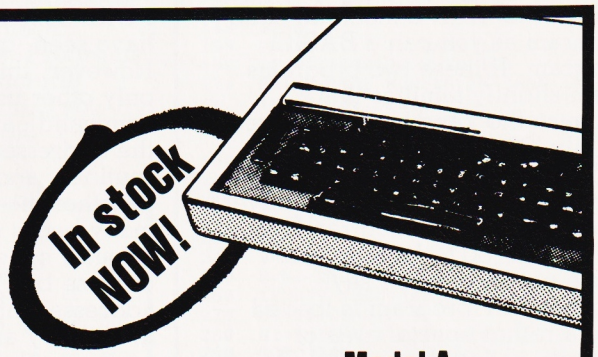

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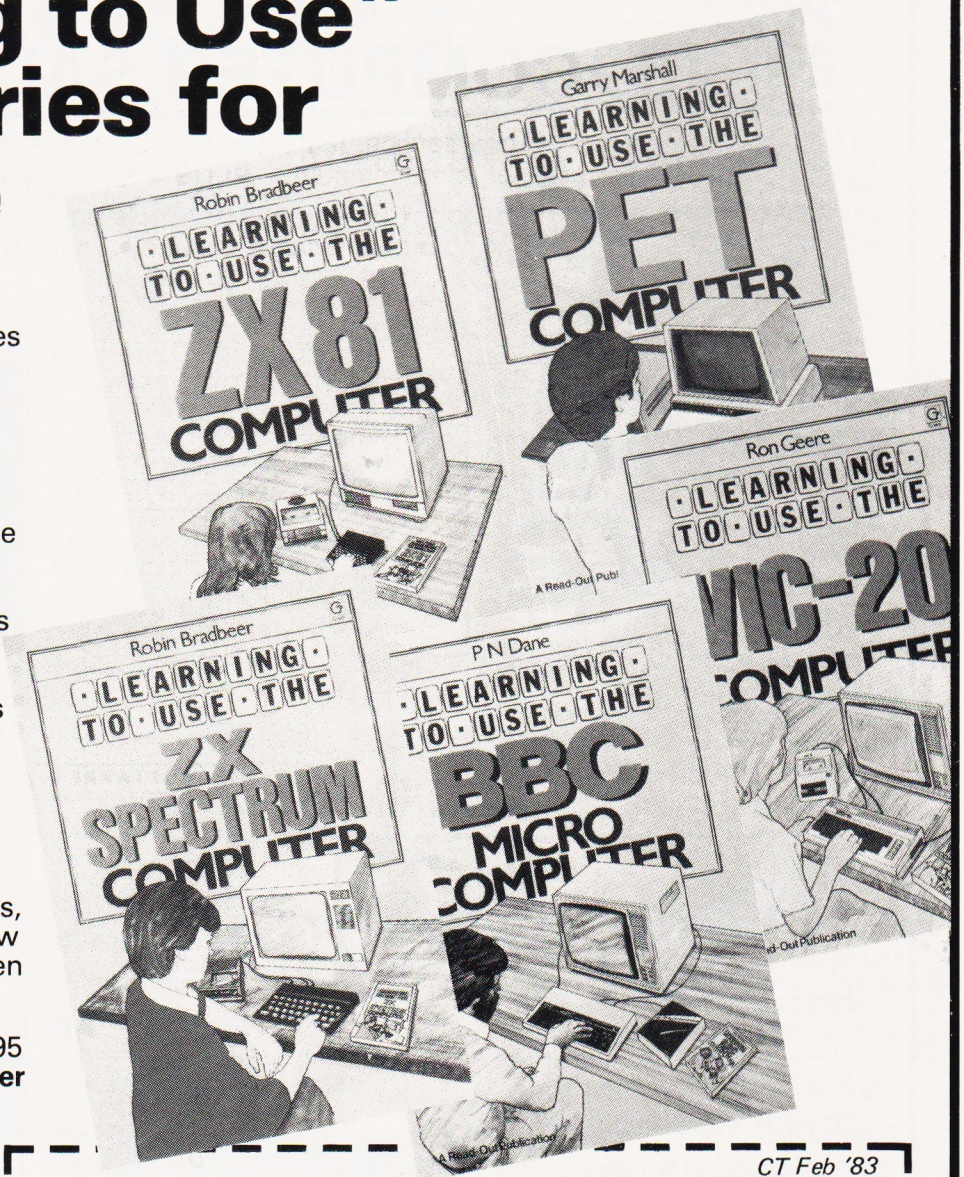

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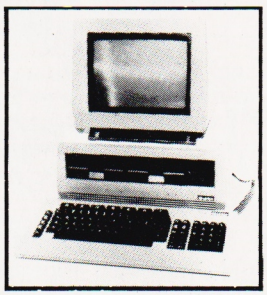

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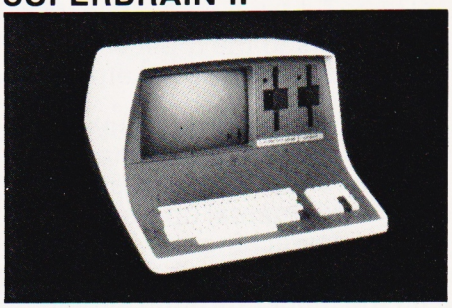

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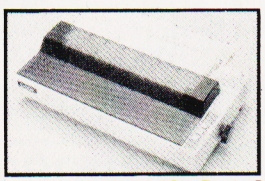

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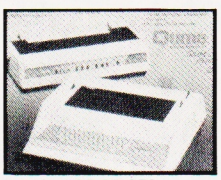

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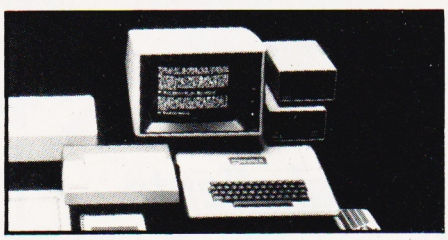

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Dear Sir,

I was extremely interested to read the letter from Dawn Walker in the November issue about the need to store information about microcomputers from magazines.

The idea of there being a standard list of keywords which could be printed at the foot of articles is one that has been around for many years and has been adopted by some industries where many of the research journals use a standard thesaurus of terms.

The computer world has been noticeably lacking in anything of this sort, however. It is ironic that the industry which is a basic tool of organising everyone else's information is so remiss in organising its own! I can remember floating this idea (in the context of mainframes - micros didn't exist then) in about 1969 or so. Some journals do put keywords at the bottom of articles, eg the Journal of the ACM, but they leave the choice to the authors and the practice is by no means common.

As you rightly point out, there are such services such as my own **Small Computer Program Index** *which do attempt to help the user in this way. It is good to see that there are more of this type of service and the one-off bibliography. The problem is that proliferation does mean a lack of standardisation, overlap and incompleteness.*

We really do need a major publisher to cover the microcomputer field systematically with a good thesaurus - perhaps with specialist sub-editions available for particular machines.

Yours faithfully,
Alan Pritchard
Bushey

(* If anyone has any ideas or suggestions on this subject please let us know. Also, if you are compiling an index or other bibliography for publication please ask us for archive material before you begin as we have a collection of magazines kept aside for this purpose. If you want more information on Alan Pritchard's **Small Computer Program Index** you can contact him through ALLM Books, 21 Beechcroft Road, Bushey, Herts WD2 2JU. Ed*).

Dear Sir,

I am thinking about moving up from a Sharp PC-1211 to a PC-1500 and CE-150 printer following the article in July's issue but I would like to know how it compares to Tandy's TRS-80 PC-2 and printer.

The glossy marketing for the latter is impressive compared with little on the former. Will either have software or hardware expansion in the near future? What about an in-depth review on the PC-2 to match the one on the PC-1500?

Yours faithfully,
M J Shelley
Streatham Vale

(* Not a lot of point really as the two machines are, to all intents, identical! Sharp have introduced an RS232 interface, there are additional RAM modules and quite a stack of software. However, why not go for the new PC-1251 which is an upgraded version of the PC-1211 and can be fitted into a cradle which incorporates a printer and microcassette à la Epson HX-20? Ed. *)

Dear Sir,

Mike James, in his Elegant Programming article, is mistaken! To paraphrase him:

No matter what he may be led to believe, you cannot store an integer inside a computer - merely some arrangement of electric charges that represents it.

Yours faithfully,
Colin Hogben
Cambridge

(* OK, but perhaps you could tell me what an electric charge is and whether the eletron density found in certain semiconductors will have any effects on the overall outcome of this argument! Accuracy, yes - pedantry, never! Ed. *)

Dear Sir,

I was most interested to read Mr Fruish's letter about the price of software and your reply. I am glad you printed his letter, despite his remarks, but it is probably even less likely that you'll print mine on this subject!

In your lengthy and interesting reply, it was interesting to note how little of it was actually about the person who writes the programs. It seems to me, that with both this and the music industry, the loudest complainers aren't the creators of the product, but the hangers on, ie the advertisers, packagers etc, who also take the largest cut of the proceeds.

What is needed are new methods to get the product, whether it be the latest pop single or computer game, from the creator to the consumer with the minimum of parasitic expense. I have been working on this myself, but unfortunately the computer chosen, although technically excellent, was never made in large enough quantities to determine whether the approach was sucessful or not.

However, if users will insist on huge, expensive advertisements, specially printed cassette labels and holders that cost more than the cassettes as well as glossy manuals etc, and patronise firms whose turnover is thereby so large that they have to charge VAT then they must expect to pay for it.

I see the way to reasonably priced software to be for the writer himself to own a small duplicator for the manual and print it himself and a tape duplicator to make the copies. If the media are willing to support such people with reasonable advertising charges then maybe we can get somewhere. The very generous VAT limits should enable such people to earn a very nice living without the need to register.

Magazines should co-operate by having specially reduced advertising charges for material that is advertised modestly, priced modestly and has been submitted to the magazine who would check that it does indeed offer good value for money.

Yours faithfully,
John de Rivaz
Truro

(* Sadly we do not yet live in Utopia and as long as the manufacturers of systems promote their material in such a way as to appeal to the mass market, as they have to to keep the costs down by making vast numbers, the peripheral industries such as software houses will be forced to ▶

follow suit. With The Valley we sought to produce a good software at as reasonable a cost as possible and the price we charge represents the fairest balance possible with an operation of this size. If we halved the cost it is doubtful that we would sell double the quantity as, to a large extent, cheap is taken as being synonymous with rubbish. What needs to be done is to educate the buyer to evaluate the program before he parts with his cash. If it does the job he wants and costs half as much as a mass advertised alternative then the buyer only has himself to blame if he buys the expensive one! Ed. *)

Dear Sir,

Thank you very much for a magazine which still thinks that the VIC-20 is a computer still to be exploited. I bought mine some 12 months ago and everyone was publishing simple programs and tips, but within about six months most of these had dried up and I had to scour the shelves of magazine shops for info on getting even more from my machine.

Last month I upgraded with a Commodore 16K RAM pack and soon afterwards found your excellent article on larger screen formats - but to my dismay, found that to use this I had to revert to a meagre 3K machine. On trying the program I found the error reported in last month's issue, namely the missing item of DATA which prevented you saving the text to tape. For those who missed it there should be a change made to line 940 as follows:

```
940 DATA 169, 1, 162, 64, 160, 31,
    32, 216, 255, 96, 234
```

With this sorted and working, I set to making it run on a 16K machine and found that it was possible with a few minor changes. These are as follows:

```
160 POKE VIC + 1,22:REM **
    YPOS OF SCREEN
220 SC = 4096:CO = 37888
230 POKE 648,16
240 MC = SC + 1024
280 Delete this line as the screen is
    now below the bottom of
    memory and BASIC will not
    interfere
840 POKE 648, 18: PRINT
    "(HOM)(17 CD)"
845 POKE 44, 16:SYS SV:POKE
    44, 22:POKE 648, 16:RETURN
850 Change 30 to 18 and 28 to 16
880 Change 28 to 16 and 29 to 17
890 Change 30 to 18 and 31 to 19
930 Change 28 to 16
940 Change 31 to 19
```

This program should now be typed in and SAVEd.

Now, key in a new program as follows:

```
10 POKE 44,22
```

Do not RUN this. Type POKE 44,22 and Return. Now LOAD the program back from tape but do not RUN it yet. A LIST will reveal the program. Type POKE 44,18 and then Return. A LIST will now show the one line program you just keyed in. Do not RUN it yet. SAVE the combined file to tape and the whole program, when LOADed, will run on a 16K machine. Note that when you do RUN it the one line program is overwritten by the screen but it doesn't matter as it is only needed to start the program up.

As a large screen requires four pages of memory, 1024 bytes, the screen program could be moved from starting at 5632, page 22, to 23040, page 90, giving enough free RAM for 17 full screens on the machine in one loading.

I hope the information is of interest to you, and particularly to other VIC-20 users.

Yours faithfully,
E H Cheers
Stafford

Dear Sir,

I have been the owner of a Dragon 32 for three weeks now and I am surprised that you found the cassette system unreliable. I use a Prinz TR-15 cassette recorder (£15.90 from Dixons) and have had no problems whatsoever.

I have experimented with data files on cassette successfully. Having previously used a Video Genie I think that the cassette system on the Dragon 32 is excellent!

Yours faithfully,
Michael Beasley
Stoke on Trent

(* I think you might have misread my comments in the Dragon 32 review. Whilst I said that the cassette system seemed level sensitive, which it is to some degree, this does not mean that it will necessarily cause trouble with your own tapes. If there are going to be loading problems they will occur on trying to load other peoples' material which has been recorded at different levels. The main criticsm I levelled at the interface was that it was supplied without a cable, OK you can get away with this on a machine that only holds 1K but not on a 32K system! However, I will agree totally that compared to something like the early Video Genies and even the Sinclair ZX81 the cassette system on the Dragon 32 is very reliable. Ed. *)

Dear Sir,

I am writing to you because, inadvertently, we left out the address on our recent insert in Computing Today. It would, therefore, be very helpful if you could give a small editorial mention confirming that if anyone is interested in taking out a trial subscription to BOJ, which is a new newsletter covering new products from Japan which are available for sale and representation in the UK, then they should write to our London office at 3 Fleet Street, London EC4. It would be most helpful if you could do this, and I thank you in anticipation.

Yours faithfully,
Nigel Wray
Business Opportunities Japan

Dear Sir,

Please find enclosed a program called Headache, designed to increase the national sales of aspirin! Seriously, though, it shows a simple routine to liven up a game written in BASIC.

```
10 FOR i = 0 TO 7:BORDER i:BEEP
0.01,-10+i:PAPER i:CLS:BRIGHT
INT RND*2:NEXT i:GOTO 10
```

Yours faithfully,
Howard L Graff
London

Dear Sir,

In the tables supporting your program The Valley, your author mentions the TSR Games Series **Monster Manuals**. *Could you please advise me of the publishers as local booksellers claim to have no record of these titles.*

You may be interested to know that I have most of The Valley running in Pascal on an Apple III.

Yours faithfully,
H P Hart
Australia

(* Always happy to oblige a fellow Adventurer! The UK address is TSR Hobbies (UK) Ltd, The Mill, Rathmore Road, Cambridge, Cambridgeshire CB1 4AD. Ed. *)

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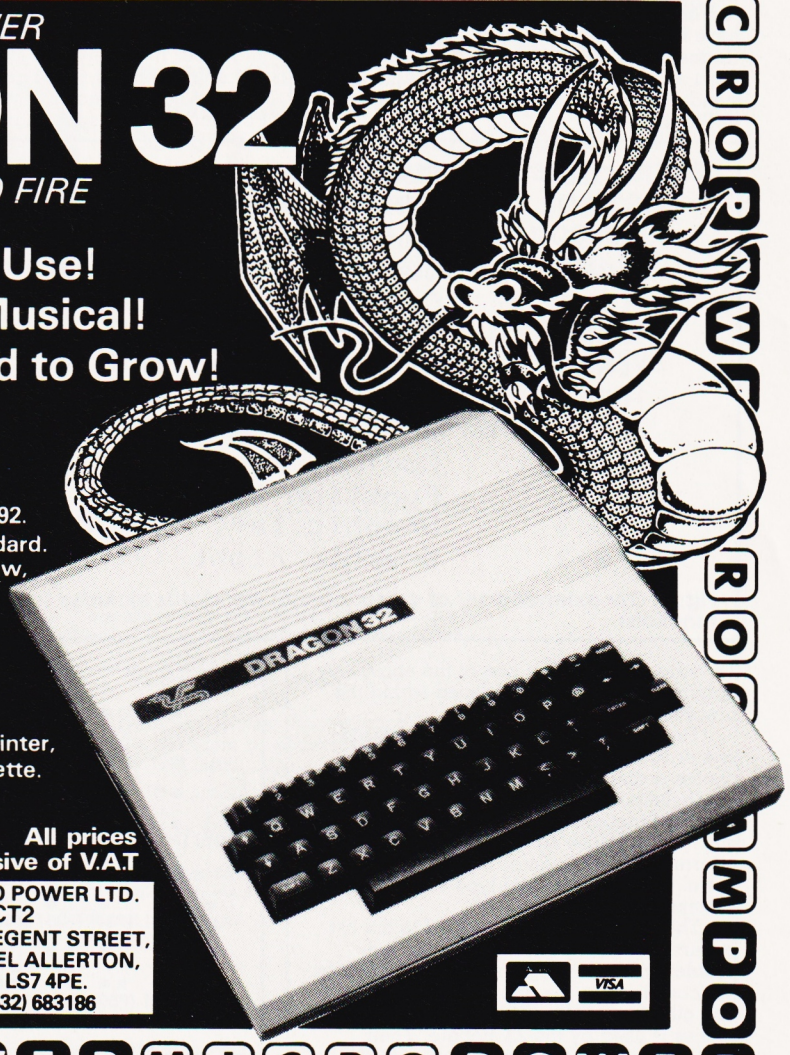

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CT STANDARDS

Our regular page explaining the meaning of the various symbols we use to make programs portable.

It has been very encouraging to see the number of programs submitted using our standard codes for graphics and other non-printable characters. However, it has also become increasingly clear that some of our readers haven't heard of them and this page is intended to set them out once again.

All standards tend to be irksome to adhere to but the ones laid out here are fairly simple and tend to make software easier to maintain by the programmer and simpler to understand for others.

CONTROL THAT CURSOR

Our original standards have now grown with the times. Machines such as the Commodore VIC which have a dual Shift capability can now be incorporated, as can those systems which use Control key functions.

The recently introduced BBC system offers pre-programmed function keys which, we are glad to say, can also be handled by our original coding system. It's nice to see just how well adapted the original standards have become over the last two years! (Indeed, a whole series of books is using them as its *de-facto* standard.) The standards for the cursor controls are given in Fig. 1.

```
[CLS]     CLear Screen
[HOM]     HOMe cursor
[CL]      Cursor Left
[CR]      Cursor Right
[CU]      Cursor Up
[CD]      Cursor Down
[REV]     REVerse video on
[OFF]     Turn it OFF
[SPC]     SPaCe
[CTL]     ConTroL key
[fn]      Function key (BBC)
[G<]      Graphic left (VIC/MZ-80A)
[G>]      Graphic right (VIC/MZ-80A)
```

Fig. 1. Our extended set of cursor control standards includes four new functions.

To indicate more than one of the above, an optional number can be placed within the brackets; [4 CL], etc.

The use of square brackets has raised one or two queries. The reason for this choice is that *most* of the common microcomputer BASICs don't use them for specific functions. In fact, at least one machine provides an added bonus by returning a Syntax Error if they are found, a useful check in case you type them in by mistake.

The code [SPC] was added to the list of cursor control codes to get over the problem of indicating just how many spaces are contained in the gap in the printout. The other common variant of the code for spaces is used by the ZX people. Their choice was '_' and this crops up in the various newsletters they publish.

The code [RVS] has caused a few headaches. This is really specific to the PET where the character set can be displayed in reversed video. On machines which don't have this facility you should either find a character in the set which is the reversed image of the one you want and use that or simply ignore it and use anything else you fancy! Don't forget, you may have to look up and alter the values used elsewhere in the program.

THE GRAPHIC SOLUTION

It soon became obvious that the techniques applied to the confusing cursor controls could also be applied to the graphics symbols. The following standard is now in general use in programs published in *Computing Today*.

If a graphics character or characters are to be displayed in a listing (as opposed to POKE codes or CHR$( ) codes) then they are indicated by the method shown in Fig. 2.

Several people have asked what the relationship between the POKE value for a character and that of its shifted graphic might be. In general the shifted version of any character will be 64 greater than the value of that character. This applies to both PET and MZ-80K systems in all cases.

This can be taken further to include machines which use a pixel graphics set rather than pre-programmed PET-style characters and the series of codes for these is given in Fig. 3. As is nearly always the case there is one machine to which the standard shown in Fig. 3 does not apply — Tangerine's Microtan/Micron. This machine uses a four by two cell structure for its pixel graphics instead of the Prestel/Teletext three by two cell. The method for calculating the value to assign to 'P' is shown in Fig. 4, and is fortunately nice and simple.

MAKING REMARKS

Many people scorn the use of REMs within programs but, during the development at least, they are extremely useful. One of the documentation methods that we use is to keep our back-up copy of our programs on a 300 Baud CUTS tape with all the REMs in place: the working copy, be it on tape or disc, is REMless in order to save space.

It is also good programming 'manners' to give your REMs odd line numbers:

```
3999 REM ** CRASH PROOF INPUT
4000 INPUT "THE NUMBER OF ENTRIES ";A
```

A remarkable number of submitted programs have jumps that go not to the relevant point in the program, but to the REM statement. This can cause severe problems when re-numbering after removing the REMs.

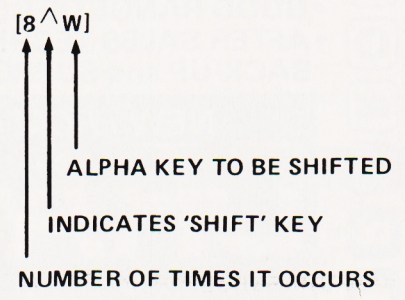

Fig. 2. The way we indicate block graphics on machines like the PET and Sharp. The VIC system of Shift Left and Shift Right is shown in Fig. 1.

1	2
4	8
16	32
64	128

Fig. 4. To convert a Tangerine pixel code into its blocks, simply decode the number into its binary or Hex value and fill in the relevant squares.

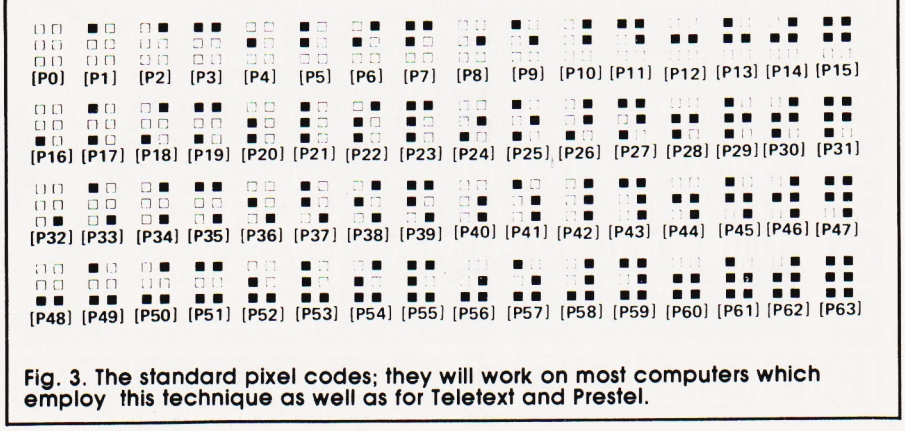

Fig. 3. The standard pixel codes; they will work on most computers which employ this technique as well as for Teletext and Prestel.

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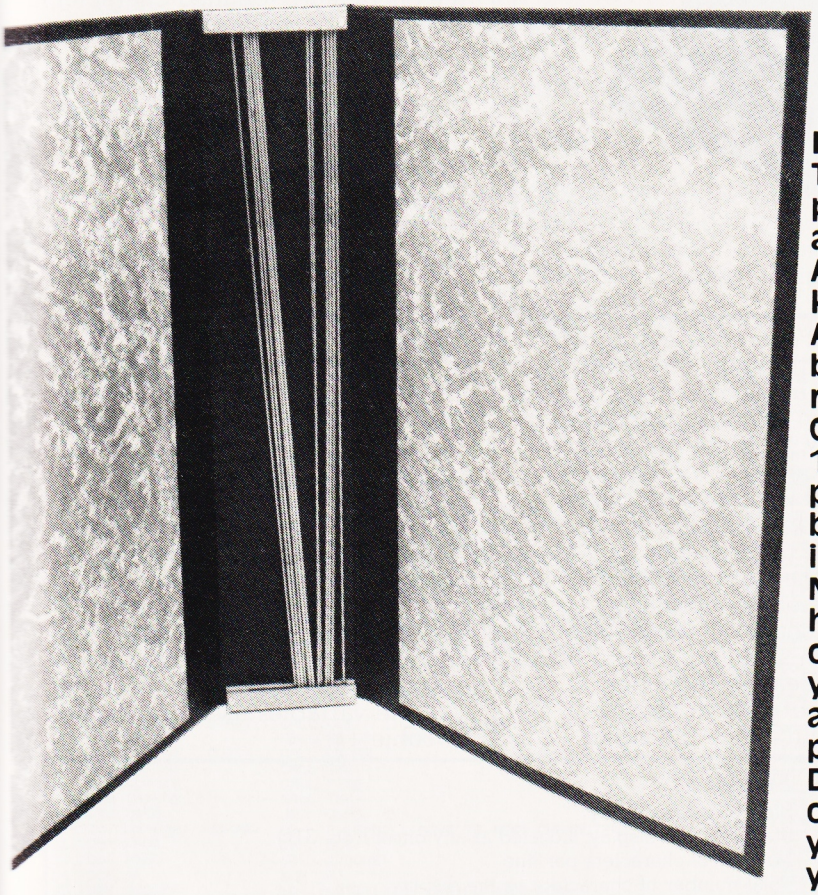

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.....

.....

Signature .....

Date .....

Peter Hewitt

CHILOTUX

An apparently simple game really, just match the letter on the left with those that appear on the right. . .perhaps it's not so simple after all!

One of the problems with machine code programs is that, unlike BASIC, you seem to get very little program for a lot of code. Of course, the resultant program makes extremely efficient use of the memory, and is accompanied by devastating efficiency (relatively speaking of course). There is, therefore, a trade-off in attempting to produce a super-zap program that doesn't consume ¾ of your 75p outlay.

THE AIM OF THE GAME

In a spirit of true British compromise (not bad for an ex-patriate of African), I present Chilotux, a simple game with the potential to drive a player beserk. The display is only five lines long, and the bottom three deal with the boring business of keeping score. The top line is similarly uninteresting, and all of the action takes place on the second line. On the left, sandwiched elegantly between two exclamation marks, is a letter which can be moved through the alphabet by hitting the Space key. From the right, marches a steadily growing string of letters (a maximum of 12 in any one run) made up, randomly, of the letters in Chilotux. When the left letter matches one of those in the string, you can 'shoot', using the Shift key. The matched letter disappears from the string, which moves back by one character. If the string successfully reaches the left-hand end, one of the three available lives is lost. On the other hand, the display can be cleared, allowing the player a crack at another 12-character string, which moves a little faster this time.

Points are scored according to the position of the zapped letter on the display — 10 for the left-most position down to 1 for the right-most. However, anybody whose eyes move independently will experience no problems in choosing the right moment to strike. The other, normally endowed, souls will have some difficulty in shooting a score better than 500. Beating the living daylights out of both keys is unsuccessful, since the string moves at sufficient speed to ensure that skill, and not brute force, prevail. To completely destroy the possibility of short-cuts, the keys won't work if they are held down.

Although the whole thing sounds ludicrously simple, there are a number of subtleties in the game which help to maintain its interest. For example, if you 'hit' the first letter to appear on the display, the fool thinks you've cleared the display, and all you get for your pains is one point, and a speed-up for the next string!!

Higher scores can be achieved by initially by-passing a letter which appears frequently in the string, and subsequently picking them off as they move into the 'ten' position — that is if your nerves will stand the strain.

Why Chilotux? Well, as many of you will be aware, it is the Swahili word for 'Memory Addressable Micro-Computer' — possibly. In addition, the letters form a nicely varied selection for random generation, and have the additional advantage, that they are the only clearly-defined characters which can be made up from the elements of a 3x3 square pixel matrix. This means there is some potential for developing the game to incorporate chunky graphics.

DECODING THE PROGRAM

The program requires 588 bytes, and is written in a reasonably standard Z80 code, although most assemblers will recognise DEFB rather than DB which seems to be unique to the Kansas Assembler. The 10 variables, plus the stack and start addresses are shown as set up for a TRS-80 running, preferably, in 32 character mode ('Video Cut' on the Video Genie). However the program uses no machine dependent routines, graphics or ASCII codes, and should, therefore, by simple adjustment of the variables, be usable on any Z80 based machine.

The variables used are shown in Table 1.

Variable	Function
STD	Start of video display.
STG	Start of game display. Located at any offset from STD.
CHL	Number of characters per line.
TCS	Total number of characters on the display.
SMV	Start of moving display. Is fixed as STG plus one line, plus three characters.
RLF	Location of 'runs' counter. Fixed as STG plus four lines plus 12 characters.
SXC	Location of end of score. Two lines up from RLF.
SPB	Address of buffer which responds to the Space key (although any key/buffer can be used).
SCC	Code, in the buffer, generated by the Space key.
SHB	Address of the buffer which responds to the Shift key. It is assumed that this generates zero (unpressed) or non-zero (pressed).

Table 1. The variables used in Chilotux and their function.

The routines used in the program are as follows:

UCHAR — Checks to see if the Space key has been hit and, if so, (routine UCH2) updates the left-letter, changing to A after Z if necessary. The game would lose most of its skill if the left-letter could be updated by holding the Space key down. To avoid this, a non-zero value is put into the temporary store location STO+1 when the Shift key is hit, and a zero when it is released. The left-

letter will only be advanced if there is a zero in this store. This means that the Space key must be consecutively released and hit to function.

FIRE — Checks to see if Shift has been hit, and includes the 'kill hold-down' described above. If the left-letter is matched in the string then it is removed from the string, which is moved back by one character (FIR3). The score is updated, according to the position of the hit string character on the display (SCR1). A check is made to see if the display has been cleared (SCR2/SCR4). If it has, then the speed is increased, and a new run is started (CONTU).

TMX — Includes a bottom count (0-255 in STO+4) and a top count (0-30 in STO+3). When *both* of these are exhausted, the string is ready to move forward. A check is made to see if it has reached the left-hand end of the display (ECHL). If it has not, then the string is moved forward one place (MBLOC), and a random letter inserted at the right-hand end (STIL). If it has, the display is flashed and cleared, and the number of 'runs' remaining is reduced by one (FINI). If this has become zero, then the game is completed (ENGM), and the high score is checked and updated if necessary (CHSC). If the 'runs' are not zero, the speed is increased, by lowering the top count, and the game re-starts (CONTU again).

The following service routines are used:

SETUP — Sets up the screen display.
HISP — Waits for Space to be hit to start the game.
PMES — Prints a message on the display.
CLS — Clears the screen.
FLN — Fills the display line with the character in register 'A'.
FLASH — Flashes a line of stars on the display.
DEG — Services the delays (MDEL/LDEL) by counting down the value in BC.
WAIT — Pause between games.

If the machine in use has any tendency to keyboard bounce, then it might be necessary to introduce an additional small delay, at the start of TMX (7DD7 Hex) thus:

```
TMX:  LD BC,100
      CALL DEG
      LD A,(STO+4)   etc....
```

The game speed will have to be altered in this case. The overall speed (controlled by the top count) is loaded at 7E68 Hex. If the processor operates faster than about 2 MHz, then this will have to be increased to get a sensible game. The speed-up is controlled by the subtraction at 7E0D Hex.

Finally, if you feel inclined to use a eight-character set other then the word Chilotux, be warned that the program also serves as an unintelligent anagram generator, and is unable to distringuish rude words!!

```
                        ORG  7D40H
                        LOAD 7D40H
                ;
                ; **   CHILOTUX   **
                ; **   BY PETER   **
                ; **    HEWITT    **
                ;
                ; -- MACHINE DEPENDENT VARIABLES --
                ;
STD:            EQU  3C00H  ;START OF DISPLAY
STG:            EQU  STD+329;START OF GAME DISPLAY
CHL:            EQU  40H    ;CHARACTERS PER LINE
SPB:            EQU  3840H  ;BUFFER FOR SPACE CHAR
SCC:            EQU  80H    ;CODE FOR 'SPACE' IN ITS BUFFER
SHB:            EQU  3880H  ;BUFFER FOR SHIFT
TCS:            EQU  400H   ;TOTAL SCREEN CHARS
SMV:            EQU  STG+CHL+3 ;START OF MOVING DISPLAY
RLF:            EQU  STG+CHL+CHL+CHL+CHL+12 ; 'RUNS' COUNTER
SXC:            EQU  RLF-CHL-CHL ;LOCATION OF SCORE
7D40 31F57F             LD   SP,7FF5H    ;LOCATE STACK
                ;
                ; -- MAIN  PROGRAM STARTS HERE --
                ;
7D43 CD817E     START:  CALL CLS    ;CLEAR SCREEN
7D46 CD447E             CALL SETUP  ;SCREEN SET-UP
7D49 CD577D     CUPC:   CALL UCHAR
7D4C CDD77D             CALL TMX
7D4F CD787D             CALL FIRE
7D52 CDD77D             CALL TMX
7D55 18F2               JR   CUPC
7D57 3A4038     UCHAR:  LD   A,(SPB)  ;MOVE TO NEXT CHARACTER
7D5A FE80               CP   SCC
7D5C 2805               JR   Z,UCH2
7D5E AF                 XOR  A
7D5F 32637F             LD   (STO+1),A   ;KILL HOLD-DOWN
7D62 C9                 RET
7D63 3A637F     UCH2:   LD   A,(STO+1)
7D66 B7                 OR   A
7D67 C0                 RET  NZ
7D68 218A3D             LD   HL,SMV-2
7D6B 7E                 LD   A,(HL)
7D6C 32637F             LD   (STO+1),A
7D6F 3C                 INC  A
7D70 FE5B               CP   "Z"+1
7D72 2002               JR   NZ,UCH1
7D74 3E41               LD   A,"A"
7D76 77         UCH1:   LD   (HL),A
7D77 C9                 RET
7D78 3A8038     FIRE:   LD   A,(SHB)      ;FIRE USING SHIFT KEY
7D7B B7                 OR   A
7D7C 2004               JR   NZ,FIR1
7D7E 32647F             LD   (STO+2),A    ;KILL HOLD-DOWN
7D81 C9                 RET
7D82 3A647F     FIR1:   LD   A,(STO+2)
7D85 B7                 OR   A
7D86 C0                 RET  NZ
7D87 218C3D             LD   HL,SMV
7D8A 3A8A3D             LD   A,(SMV-2)
7D8D 32647F             LD   (STO+2),A
7D90 010A00             LD   BC,10
7D93 EDB1               CPIR
7D95 C0                 RET  NZ
7D96 EB                 EX   DE,HL        ;MATCH FOUND
7D97 1B                 DEC  DE
7D98 D5                 PUSH DE
7D99 E1                 POP  HL
7D9A 2B                 DEC  HL
7D9B 3E09               LD   A,9
7D9D 91                 SUB  C
7D9E 4F                 LD   C,A
7D9F C5                 PUSH BC
7DA0 2802               JR   Z,FIR3
7DA2 EDB8               LDDR              ;MOVE LINE BACK
7DA4 3E20       FIR3:   LD   A," "
7DA6 328C3D             LD   (SMV),A
7DA9 C1                 POP  BC
7DAA 3E0A               LD   A,10
7DAC 91                 SUB  C
7DAD 4F                 LD   C,A
7DAE 21D53D             LD   HL,SXC       ;UPDATE SCORE
7DB1 7E         SCR1:   LD   A,(HL)
7DB2 81                 ADD  A,C
7DB3 FE3A               CP   "9"+1
7DB5 3808               JR   C,SCR2
7DB7 D60A               SUB  10
7DB9 77                 LD   (HL),A
7DBA 2B                 DEC  HL
7DBB 0E01               LD   C,1
7DBD 18F2               JR   SCR1
7DBF 77         SCR2:   LD   (HL),A
7DC0 218C3D             LD   HL,SMV       ;DISPLAY CLEARED ??
7DC3 060A               LD   B,10
7DC5 CB6E       SCR4:   BIT  5,(HL)
7DC7 C8                 RET  Z
7DC8 23                 INC  HL
7DC9 10FA               DJNZ SCR4
7DCB 114E7F             LD   DE,MCL
7DCE CD0C7F             CALL WAIT
7DD1 218C3D             LD   HL,SMV
7DD4 182A               JR   CONTU
7DD6 C9                 RET
7DD7 3A667F     TMX:    LD   A,(STO+4)  ;CHECK IF A MOVE IS DUE
7DDA 3D                 DEC  A
7DDB 32667F             LD   (STO+4),A
7DDE C0                 RET  NZ
7DDF 3A657F             LD   A,(STO+3)  ;TOP COUNT
7DE2 3D                 DEC  A
7DE3 32657F             LD   (STO+3),A
7DE6 C0                 RET  NZ
7DE7 3A677F             LD   A,(STO+5)  ;TIME UP. RELOAD TOP COUNT
7DEA 32657F             LD   (STO+3),A
7DED 218C3D     ECHL:   LD   HL,SMV     ;LETTERS REACHED LH END ??
7DF0 CB6E               BIT  5,(HL)
7DF2 201F               JR   NZ,MBLOC
7DF4 3A553E     FINI:   LD   A,(RLF)    ;UPDATE NO OF RUNS
7DF7 3D                 DEC  A
7DF8 32553E             LD   (RLF),A
7DFB FE30               CP   "0"
7DFD CA0C7E             JP   Z,ENGM
7E00 CD817E     CONTU:  CALL FLASH
7E03 AF                 XOR  A
7E04 32627F             LD   (STO),A
7E07 CD917E             CALL HISP
7E0A 3A677F             LD   A,(STO+5)
7E0D D603               SUB  3            ;SPEED CHANGE - AMEND AS REQUD.
7E0F 32677F             LD   (STO+5),A    ;INCREASE SPEED
7E12 C9                 RET
7E13 218D3D     MBLOC:  LD   HL,SMV+1     ;MOVE LINE UP ONE PLACE
7E16 118C3D             LD   DE,SMV
7E19 010900             LD   BC,9
                        LDIR
7E1E 3A627F             LD   A,(STO)
7E21 3C                 INC  A
7E22 32627F             LD   (STO),A
7E25 FE0D               CP   13
7E27 3804               JR   C,STIL
7E29 3E20               LD   A," "
7E2B 180C               JR   PLL
7E2D ED5F       STIL:   LD   A,R
7E2F CB3F               SRL  A
7E31 E607               AND  7            ;RANDOM NO IN RANGE 0-7
7E33 21767F             LD   HL,LETS
7E36 4F                 LD   C,A
7E37 09                 ADD  HL,BC
7E38 7E                 LD   A,(HL)
7E39 32953D     PLL:    LD   (SMV+9),A
7E3C C9                 RET
7E3D E5         PSHL:   PUSH HL
7E3E CD797E             CALL PMES
7E41 E1                 POP  HL
7E42 09                 ADD  HL,BC
7E43 C9                 RET
7E44 21493D     SETUP:  LD   HL,STG       ;SCREEN SET-UP
7E47 11197F             LD   DE,NUS
7E4A 014000             LD   BC,CHL
7E4D CD3D7E             CALL PSHL
7E50 117E7F             LD   DE,FRM
7E53 CD3D7E             CALL PSHL
```

```
7E56 11277F          LD   DE,SCR
7E59 CD3D7E          CALL PSHL
7E5C 11857F          LD   DE,HSC
7E5F CD3D7E          CALL PSHL
7E62 11687F          LD   DE,RUNS
7E65 CD797E          CALL PMES
7E68 3E30            LD   A,30H        ;SETS INITIAL SPEED (TOP COUNT)
7E6A 32677F          LD   (STO+5),A    ;INITIALISE STORE
7E6D 32657F          LD   (STO+3),A
7E70 AF              XOR  A
7E71 32627F          LD   (STO),A
7E74 32667F          LD   (STO+4),A
7E77 1818            JR   HISP
7E79 1A        PMES: LD   A,(DE)       ;PRINT MESS DE @ HL
7E7A B7              OR   A
7E7B C8              RET  Z
7E7C 77              LD   (HL),A
7E7D 23              INC  HL
7E7E 13              INC  DE
7E7F 18F8            JR   PMES
7E81 1620      CLS:  LD   D," "
7E83 21003C          LD   HL,STD
7E86 010004          LD   BC,TCS
7E89 72        CL1:  LD   (HL),D
7E8A 23              INC  HL
7E8B 0B              DEC  BC
7E8C 78              LD   A,B
7E8D B1              OR   C
7E8E 20F9            JR   NZ,CL1
7E90 C9              RET
7E91 3E40      HISP: LD   A,"A"-1      ;WAIT FOR SPACE & START
7E93 328A3D          LD   (SMV-2),A
7E96 218C3D          LD   HL,SMV
7E99 E5              PUSH HL
7E9A 11577F          LD   DE,MHS
7E9D CD797E          CALL PMES
7EA0 3A4038    HIS1: LD   A,(SPB)
7EA3 FE80            CP   SCC
7EA5 20F9            JR   NZ,HIS1
7EA7 E1              POP  HL
7EA8 3E20            LD   A," "
7EAA 060A      FLN:  LD   B,10         ;FILL DISPLAY LINE WITH "A"
7EAC 77        FL1:  LD   (HL),A
7EAD 23              INC  HL
7EAE 10FC            DJNZ FL1
7EB0 C9              RET
7EB1 060C      FLASH: LD  B,12         ;FLASH LINE OF STARS
7EB3 3E2A      FL2:  LD   A,"*"
7EB5 CDC07E          CALL FL3
7EB8 3E20            LD   A," "
7EBA CDC07E          CALL FL3
7EBD 10F4            DJNZ FL2
7EBF C9              RET
7EC0 328A3D    FL3:  LD   (SMV-2),A
7EC3 E5              PUSH HL
7EC4 C5              PUSH BC
7EC5 CDAA7E          CALL FLN
7EC8 CDD37E          CALL MDEL
7ECB C1              POP  BC
7ECC E1              POP  HL
7ECD C9              RET
7ECE 010000    LDEL: LD   BC,0         ;DELAYS
7ED1 1803            JR   DEG
7ED3 010020    MDEL: LD   BC,2000H
7ED6 0B        DEG:  DEC  BC
7ED7 78              LD   A,B
7ED8 B1              OR   C
7ED9 20FB            JR   NZ,DEG
7EDB C9              RET
7EDC CDB17E    ENGM: CALL FLASH        ;END GAME,UPDATE HIGH SCORE
7EDF CDB17E          CALL FLASH
7EE2 11437F          LD   DE,MGO
7EE5 CD0C7F          CALL WAIT
7EE8 11D13D          LD   DE,SXC-4
7EEB 213D7F          LD   HL,HSC+8
7EEE 0605            LD   B,5
7EF0 4E        CHSC: LD   C,(HL)
7EF1 1A              LD   A,(DE)
7EF2 B9              CP   C
7EF3 3813            JR   C,PNM
7EF5 280D            JR   Z,CARON
7EF7 21D13D          LD   HL,SXC-4
7EFA 113D7F          LD   DE,HSC+8
7EFD 010500          LD   BC,5
7F00 EDB0            LDIR
7F02 1804            JR   PNM
7F04 23        CARON: INC  HL
7F05 13              INC  DE
7F06 10E8            DJNZ CHSC
7F08 CD447E    PNM:  CALL SETUP
7F0B C9              RET
7F0C 218C3D    WAIT: LD   HL,SMV
7F0F CD797E          CALL PMES
7F12 CDCE7E          CALL LDEL
7F15 CDCE7E          CALL LDEL
7F18 C9              RET
7F19 20202058  NUS:  DB   "   X987654321",0
7F1D 39383736
7F21 35343332
7F25 3100
7F27 53434F52  SCR:  DB   "SCORE : 00000",0
7F2B 45203A20
7F2F 30303030
7F33 3000
7F35 48494748  HSC:  DB   "HIGH  : 00000",0
7F39 20203A20
7F3D 30303030
7F41 3000
7F43 47414D45  MGO:  DB   "GAME  OVER",0
7F47 20204F56
7F4B 455200
7F4E 20434C45  MCL:  DB   " CLEARED",0
7F52 41524544
7F56 00
7F57 48495420  MHS:  DB   "HIT  SPACE",0
7F5B 20535041
7F5F 434500
7F62 00000000  STO:  DB   0,0,0,0,0,0
7F66 0000
7F68 52554E53  RUNS: DB   "RUNS LEFT : 3",0
7F6C 204C4546
7F70 54203A20
7F74 3300
7F76 4348494C  LETS: DB   "CHILOTUX"
7F7A 4F545558
7F7E 21202120  FRM:  DB   "! !          !",0
7F82 20202020
7F86 20202020
7F8A 202100
7F8D                 END
```

The complete assembly code listing for Chilotux. The start address is configured for a TRS-80 but conversion to other Z80-based systems should be a very simple matter.

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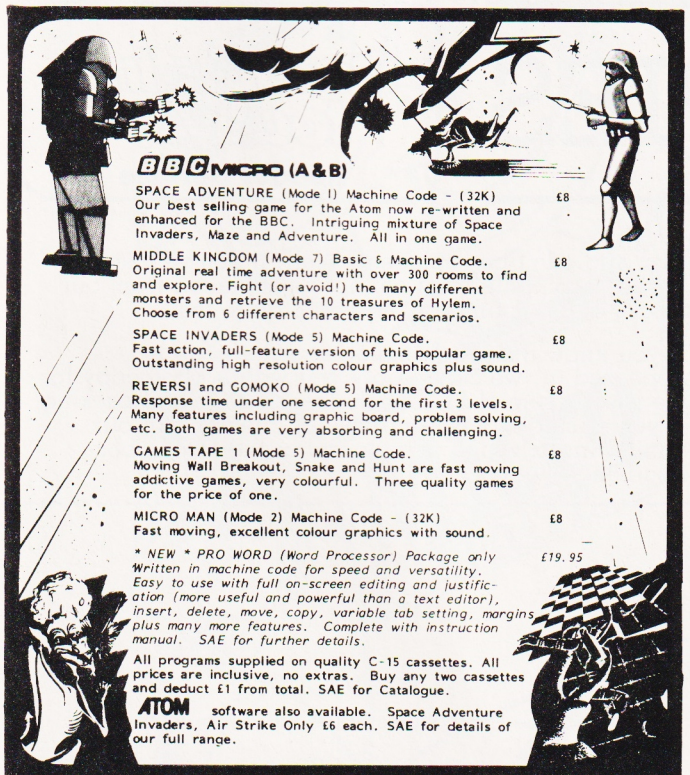

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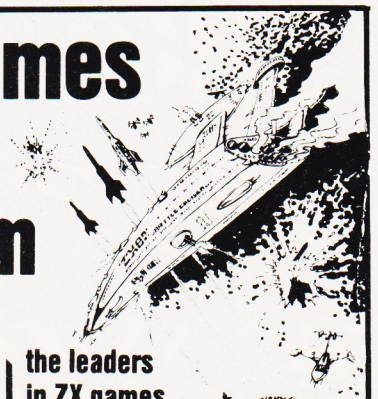

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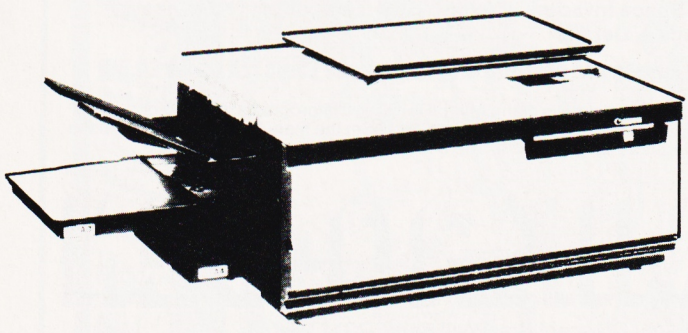

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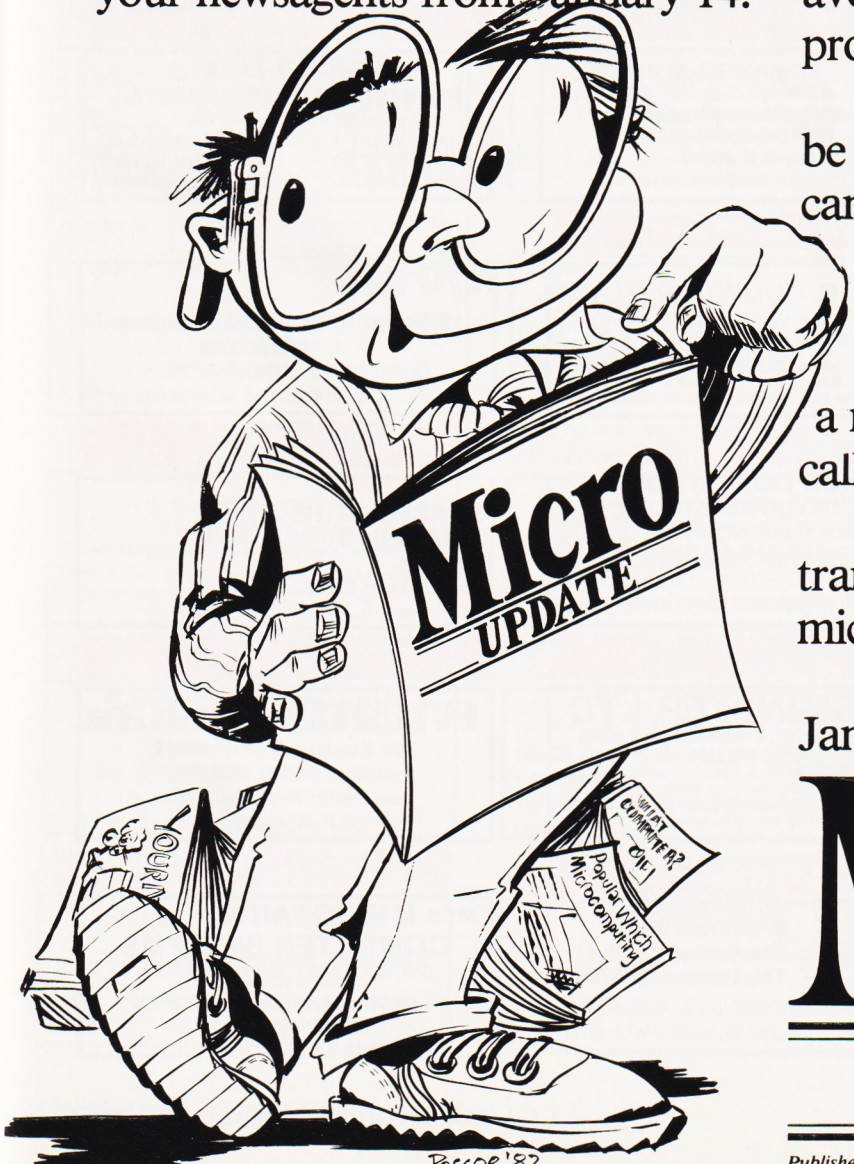

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LASERBUG
10 Dawley Ride,
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Contact: Paul Barbour

LASERBUG started off life as a BBC User group based around London but is now an international group with members in 14 countries worldwide. A comprehensive magazine is sent to all members monthly. Local meetings are arranged via the newsletter. Membership is £12.00 for 1 year which includes 12 copies of the magazine plus special members only discounts.

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IRISH AMATEUR COMPUTER CLUB
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This recently formed club would like to hear from anyone interested in personal computing in the Dublin area and other parts of Ireland. Contact Martin at the above address, or send an SAE to Brendan Haligan at 22 Gortmore Avenue, Finglas Sth. Dublin 11.

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Tel: 031-661 3183
Contact: Keith Mitchell (Secretary)

Owners of Sinclair ZX80 and ZX81s are welcomed by this club which meets every second and fourth Wednesday of each month at the Claremont Hotel, Claremont Crescent, Edinburgh, at 7.30pm. The club holds various activites, including tutorials, workshops and visits, and also produces a bi-monthly newsletter. Annual membership is £5 for adults and £3 for children.

FARNHAM COMPUTER CLUB
14 Thorn Road,
Boundstone,
Farnham,
Surrey
Contact: Adam Sharp

This club, aimed at professionals, amateurs or anyone simply interested in computers, meets every second Wednesday in the month at Farnham Sixth Form College, Morley Road, Farnham at 7.30pm. The membership is £2.00 per annum, so if you are at all interested, either write or go along to the above address and not to the college.

NORTHWEST MICROCOMPUTER USERS GROUP
22 Chapel Lane,
Coppull,
Nr. Chorley,
Lancashire
Tel: Standish 426252
Contact: Peter Jones

Now entering its fourth year, the club has over 165 members who use a wide variety of micros. Since members come from a large area, meetings are rotated between Leyland, Chorley, Skelmersdale, Wigan and Bolton. The club produces a newsletter with forthcoming events and programming hints.

CATERHAM LEISURE CENTRE COMPUTER CLUB
Caterham Leisure Centre,
Godstone Road,
Caterham,
Surrey CR3 6RE
Tel: Caterham 48304 (M Goldsbrough) or Caterham 43316 (J Hodges)
Contact: M Goldsbrough (Centre Manager) or J Hodges.

The club has started at the Leisure Centre which has a Model B BBC Micro available. Meetings are on Thursday nights at 8.00pm and new members (and their micros) are welcome to come along.

WEST MIDLANDS COMPUTER GROUP
12 Apsley Road,
Oldbury,
West Midlands B68 0QZ
Contact: Steve Walker

Set up at the end of August 1982, the Group aims to provide a forum for micro users in the West Midlands. There is a monthly magazine, DATABUS, ten issues of which are included in the annual subscription of £3. Machines catered for at present included the BBC Micro, Sinclair ZX81 and Spectrum, NASCOM and Dragon 32. More information and membership forms can be obtained from Steve Walker or in person at The Byte Shop, Hurst Street, Birmingham.

BANGOR AND DISTRICT MICROCOMPUTER USERS GROUP
Fodol Farm,
Hafod Lane,
Caernarfon Road,
Bangor,
Gwynedd,
North Wales LL55 4BU
Contact: Dilwyn Jones (Co-ordinator)

The club meets fortnightly in Bangor Community Centre, High Street, Bangor, in Room 1A at 7.30pm.

SOUTH NORTHANTS MICROCOMPUTER USERS GROUP
83 Watling St. West,
Towcester,
Northamptonshire. NN12 7AG
Tel: 0327-52191
Contact: Simon Clark

Whether you own a micro or not the Group would like to invite you to their weekly meetings at the A5 Ranger's Hall, Watling St. West, Towcester on Wednesday evenings at 7.30pm. The micros used include the BBC Micro, Sinclair ZX81 and Spectrum, TRS-80, and NASCOM. The cost per meeting which only covers room-hire depends purely on the number of people attending, so the more the merrier (and cheaper!)

ACORN ATOM USERS GROUP
44 3rd Street,
Booysens Reserve,
Booysens,
Johannesburg,
South Africa
Tel: 010 27 11 835-2031 (work) or 010 27 11 976-1491 (home)
Contact: John Dowling

This small (at present!) club would like to expand by inviting more ATOM users to their meetings which are held on the first Tuesday of every month at 7.00pm.

PORTSMOUTH CO-OPERATIVE COMPUTER CLUB
30 Delmere Road,
Southsea
Tel: 0705-830623
Contact: A H May (Secretary)

A new club has started up in Portsmouth for interested amateurs of all age groups. The club meets every Sunday evening at 7.00pm at 53a Heidelberg Road, Devonshire Square, Southsea.

BOLTON COMPUTER CLUB
16 Douglas Street,
Atherton,
Manchester M29 9FB
Tel: Bolton 493682 (Ray Mumford) or Atherton 876210 (Dave Atherton)
Contact: Ray Mumford (Chairman) or Dave Atherton (Secretary)

The club has only recently started and has weekly meetings on Thursdays in Room E4/24 at the Bolton Institute of Technology. Anyone who has any computing interest is welcome, although the majority of present members are home micro hobbyists. Membership is £1 pa with a 20p admission charge at some meetings.

CUSTOM 80 USER GROUP
16 Queens Avenue,
Meols,
Wirral,
Merseyside L47 0LU
Tel: 051-632 4788
Contact: C A Hayes

This is a newly formed user group catering exclusively for the Custom 80 colour micro. A bimonthly newsletter is circulated and the annual subscription is £1.50 for the UK and £3 for overseas.

INDEPENDENT COMMODORE PRODUCT USER GROUP
97 Shelley Road,
Chelmsford,
Essex CM2 6E5
Tel: Chelmsford 81878
Contact: A G Surridge

The club meets every first and third Tuesday at Maxton-Hayman, 5 Broomfield Road, Chelmsford. Most of the members own VIC-20s but a few other types are to be found. For further details and a map to locate the meeting place send an SAE to the above address.

SHARP MZ-80K USER GROUP
19 Madingley Road,
Cambridge CB3 0EG
Contact: Piers Hendrie

Attention all Sharp MZ-80K owners living in the Cambridge area. This is a new Group which produces an occasional newsletter with useful hints and advice and some programs. Membership is free and there is a library which can be used if a member sends an SAE and a blank cassette.

PENCOED AMATEUR COMPUTER CLUB
38 Bryn Rhedyn,
Pencoed,
Bridgend CF35 6TL
Tel: 0656-860307 (after 6.00pm)
Contact: Philip Williams

This recently formed club meets every second Saturday at the Pencoed Library, near Bridgend. The membership is £5 pa and meetings start at 3.00pm.

TRITON INDEPENDENT USER GROUP
4 Guffitts Rake,
Meols,
Wirral,
Merseyside L47 7AD
Contact: John Owen

The club, which has over 150 members, would like to hear from all the other Triton users in the area. The annual subscription is £5, giving members access to a free software exchange library and technical advice service in addition to the quarterly, The Triton Magazine. All enquiries should be accompanied by an SAE.

Before we leave our Club Call for this month, our help has been solicited by J R Mayhew who would like to get together with other micro owners to form a club in the Tilbury, Chadwell and Grays area of Essex. Anyone interested (over 16 please) should call Tilbury 2424, c/o Tilbury Community Centre.

If you would like to be included on this page, please drop us a line at:

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Computing Today,
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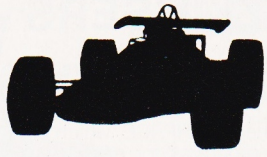

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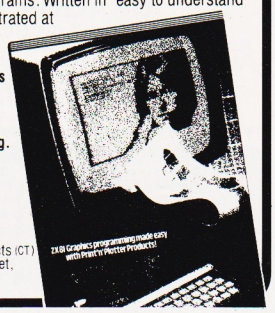

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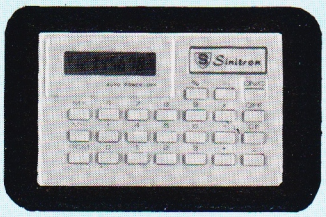

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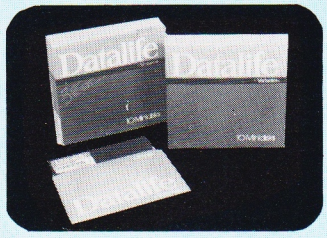

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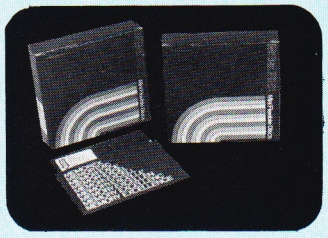

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